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OF THE

BOTANICAL DEPARTMENT.

New Series.]

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Vol. I.

Part 1.

LIBERIAN COFFEE.

COFFEA LIBERICA, Bull.

Liberian Coffee is a native of Guinea, and is found on the low hills from near the sea-coast to considerable distances inland. The climate of the west coast of Africa is very damp and the rainfall heavy.

This species grows naturally into a tree, 20 to 40 feet high, with a long tap root. The berries are much larger than those of ordinary coffee, and do not drop from the branches for a long time after they are ripe. They differ also in the pulp becoming very hard, when dry.

Soil.—The soil should be deep, rich, and friable. Soil that is very shallow or altogether clayey, and situations where water is retained for any time, must be avoided for plantations. But a certain amount of clay mixed with stones or limestone debris is not prejudicial, if the drainage is perfect.

Climate.—Although in Liberia this coffee grows with an excessive rainfall, said to be 187 inches, it is certain that such a large amount is not by any means necessary. It gives large crops at Castleton Gardens with a rainfall of 110 inches and a mean temperature of 76° F., at an elevation of 580 feet. Even at Hope Gardens with an average rainfall of 55 inches, it grows well, and produces a crop; and probably in situations as dry as the Liguanea plains, it would, if irrigated, bear heavily.

Elevation.—It is essentially a tropical plant, and probably would not succeed at higher elevations than 2,500 feet, but where ordinary coffee does well, there is no need to replace it by its rival. In any suitable places below the lower limit for ordinary coffee, it would repay cultivation.

Planting.—The seeds may be sown in a nursery in beds about 4 feet

wide in good soil well dug and pulverised. They should be sown 3 or 4 inches apart, and afterwards transplanted into bamboo joints for convenience of carriage to the fields. They may also be sown in bamboo pots at first. The nursery should be shaded from the direct rays of the sun.

When the plants are put out in their permanent position, they will still require shade, and perhaps bananas are the most suitable plants for this purpose. It is possible that in dry situations, permanent shade trees will be found necessary, and perhaps the best are the guango, the bread fruit, and jack fruit trees.

The distance apart for planting depends a good deal on the soil, and whether the tree is topped. It may vary from 8 to 12 feet.

Topping.—As to topping Liberian Coffee trees some planters do not top them, but allow them to grow up naturally. In Liberia they are topped down to 5 feet, and planters there say that they obtain larger crops by this plan. When the trees grow up high, considerable injury may be done by careless pickers. It may be found that 5 feet is too low, and 8 feet for instance, a better height; but just as the practice of topping ordinary coffee varies throughout the island, it will be found necessary to experiment with Liberian Coffee and discover the best method for each district.

Yield.—Extracts are given below from the *Kew Bulletin* showing that crops of 9 to 12 cwt. per acre can be obtained from trees after the third or fourth year.

Pulping. The tough fibrous character of the pulp renders the ordinary coffee pulper quite unsuitable for use with Liberian Coffee, and for some time after attention had first been called to this new product by Sir Joseph Hooker from Kew, no satisfactory pulping machine was invented.

Now however, a machine has been devised by Messrs. John Gordon & Co., 9 New Broad St., London, E.C., and on application to them, they have supplied the following information about their pulper, which is the only special machine required for treating Liberian Coffee, as all the other machines treat Arabian and Liberian Coffee equally well:—

“The annexed engraving represents Gordon’s Improved Coffee Pulpers which has been specially designed for pulping Liberian Coffee.

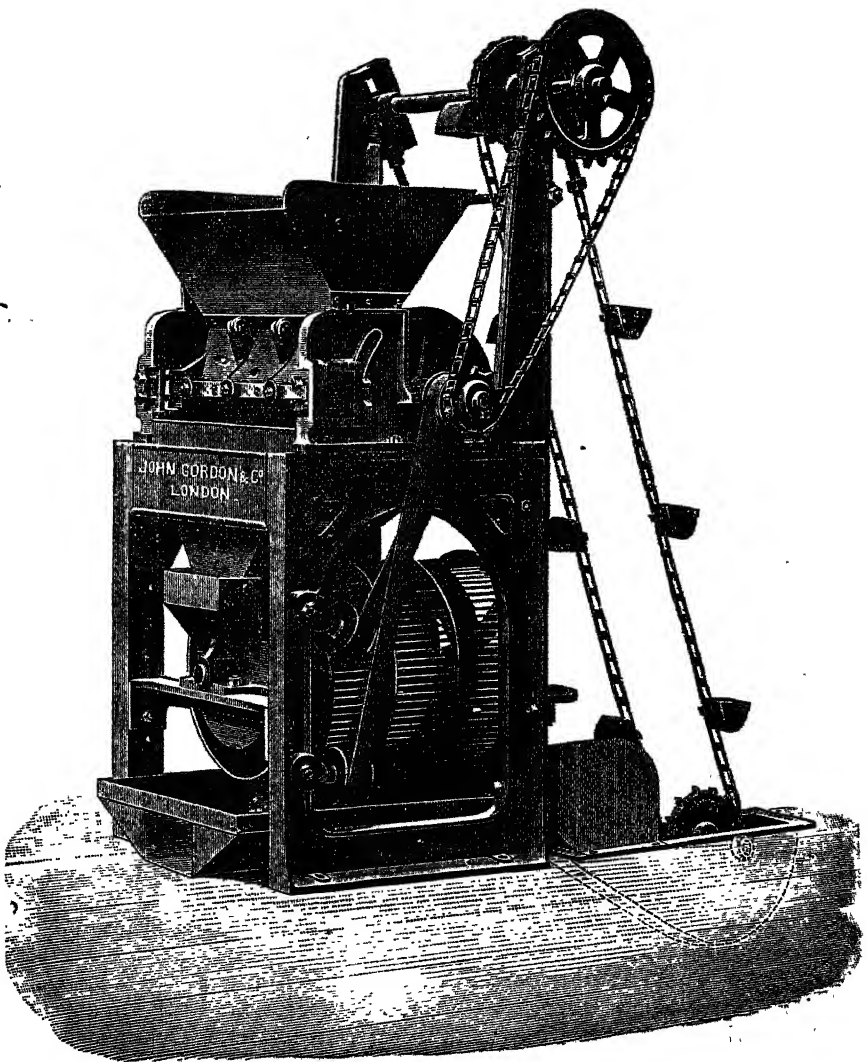
“John Gordon & Co. have made many experiments for the purpose of obtaining an efficient machine for pulping this kind of coffee, and they now venture to submit this machine to planters, as the result of their labours, with confidence that it will be found to possess a greater efficiency than any machine hitherto offered for this purpose.

“The machine is provided with a Rotary Screen and an Elevator; it is also fitted with a patent Adjustable Breast, having removable working parts made of steel.

“The Hopper is divided into two unequal parts, and the coffee berries are delivered into the larger division with a constant stream of water, the water being absolutely necessary to float the coffee over into the machine, and to carry off the pulp and skins. The coffee

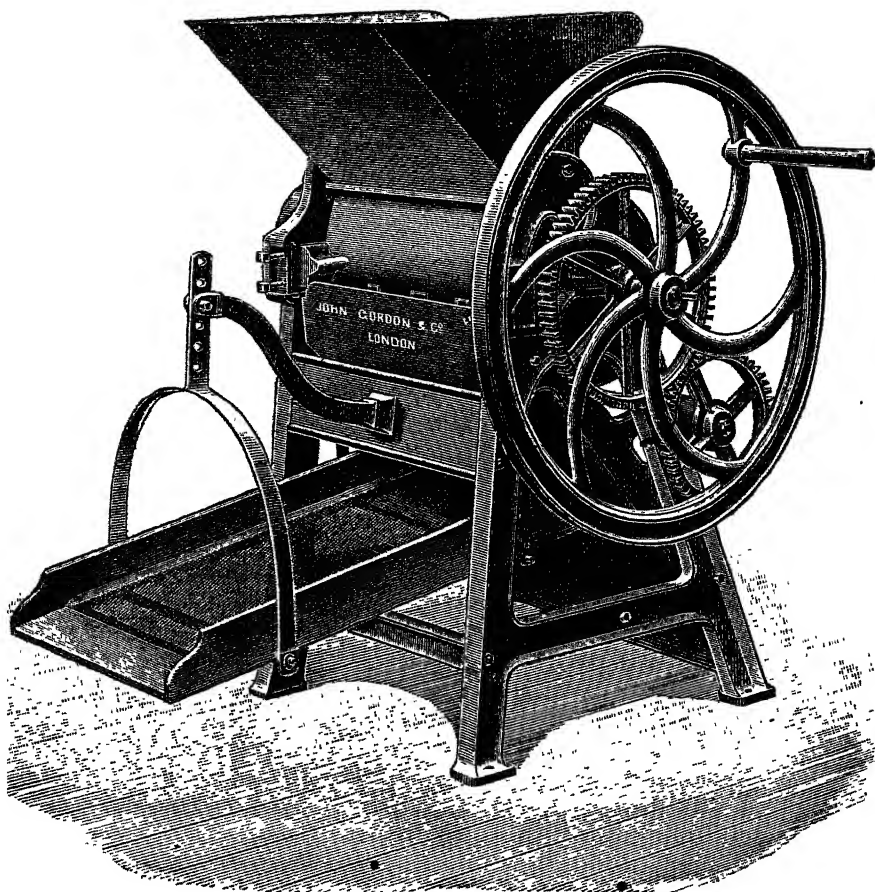
berries, which, owing to difference in size, pass through the machine unpulped, are discharged by the Screen into the Elevator, and delivered by it into the smaller division of the hopper, and thence it passes into a separate channel of the breast, which should be adjusted to the size of the berries thus brought into the machine by the Elevator.

“The working of the machine is simple, and the only part which requires care is the breast, and if this be carefully fixed and its channels intelligently regulated, no difficulty whatever will be found in obtaining good results, always provided that the coffee be *ripe and freshly picked*.



“ We give particulars and prices of single and double Pulpers :—

	Single.	Double.
Complete, packed for shipment	£60	£110
Gross weight in lbs.	1,684	3,244
Measurement in cubic feet	48	124
Number of packages	6	10
Will pulp ripe Coffee per hour, in lbs.	1,100	2,200



* This engraving represents our Liberator Pulper, without Elevator, and with a Flat Oscillating Sieve, in place of the Rotary Screen, and which, although not equal to our Improved Pulpers, illustrated and described above, some of our friends have been able to do very good work with them. They are similar to our ordinary A and B size Pulpers, which have been so successful with Arabian Coffee, but they are provided with special Breast and Cylinder for the treatment of Liberator Coffee. These Machines can be worked

either by Hand or by Steam. In order to obtain good results, it is imperative that the Coffee be *ripe, freshly picked, and led into the Hopper with a constant stream of water.* They are made in two sizes:—

	12 ins.	24 ins.
Complete, packed for shipment	£28	£47
Gross weight in lbs.	830	1,232
Measurement in cubic feet	29	40
Number of packages	5	6
Will pulp ripe Coffee per hour in lbs.	700	1,400

“We make larger Pulpers than those shewn on this sheet and which are provided with a Separator for classifying the Cherry Coffee, each size thus obtained being delivered into a particular channel adjusted to that size. This arrangement greatly assists the perfect pulping of the berries, since the machine has practically to deal with berries of the same size.

“A Separator also can be used in conjunction with two or more separate Pulpers, each Pulper adjusted to take one size of berry.”

In Java the Liberian Coffee cherries are fermented before they are pulped.

Messrs. Gordon state in the *Kew Bulletin*:—

“We have supplied pulpers for Liberian Coffee to Java, West Coast of Africa, and mostly to the Malay Peninsula. One firm there, Messrs. Hill & Rathbone, have had six or seven pulpers; they have also our peelers and separators. . . .

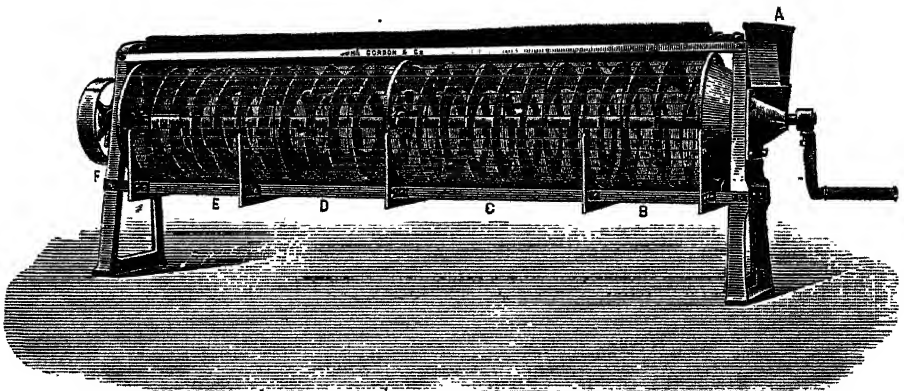
“*It is quite imperative that water be used in pulping*, and where it is not obtainable the *only* course, we fear, is to dry the coffee in the cherry, when it can very well be peeled, only this takes some power . . .

“Our peelers and separators will treat Liberian equally as well as ordinary Arabian Coffee, and as far as these machines are concerned there is no difference of construction. It is only in the operation of pulping where difficulty has been found, necessitating a special pulper.”

Illustrations of their peelers and separators given below may also be of use to planters who are thinking of taking up this cultivation:—

CYLINDRICAL SEPARATOR.

For Pulped Coffee.



"The annexed engraving represents a machine for separating the pulp from the coffee after it has been discharged from the pulper.

"This machine is very simple and complete, and only requires to be fixed on two wooden beams over a tank containing water. The cylinder should be immersed in the water to the depth of about four inches.

"It is substantially constructed of very stout iron rods, securely fixed in wrought iron rings, as shewn; the Hopper, bearing and mouth piece at the feed ends, being in one piece.

"The cylinder is also fitted with an internal worm or screw for propelling forward the pulp.

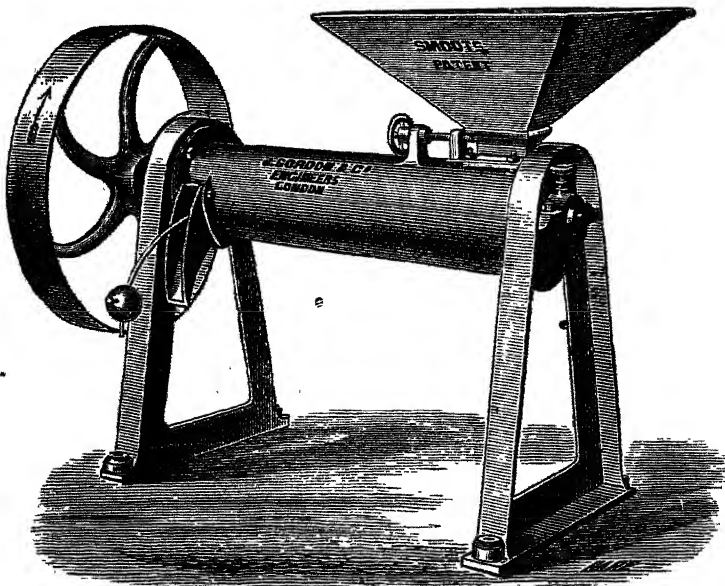
"It is made in the following, or any intermediate lengths, at proportionate prices, and can be supplied either thoroughly well painted, or galvanized:—

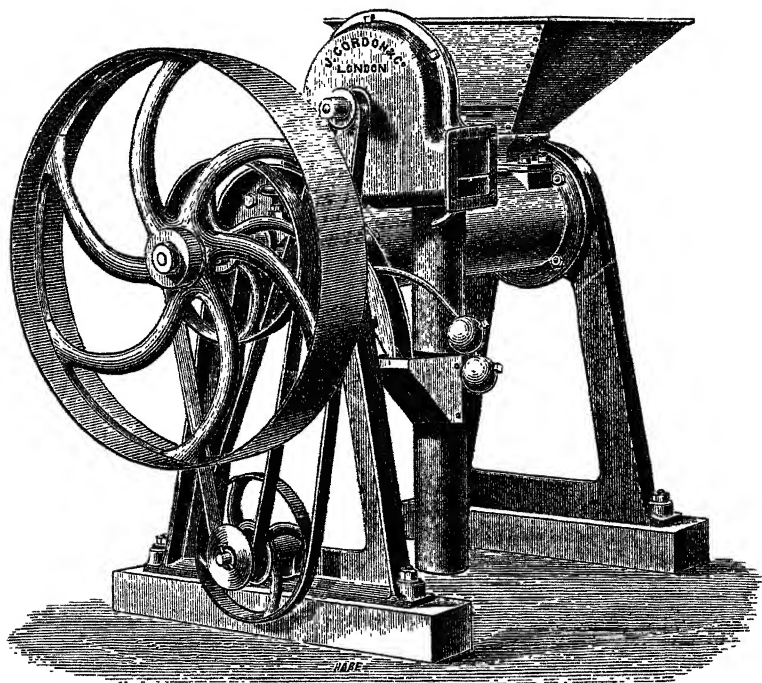
Length in feet.	Diameter in inches.	Painted.	Galvanized.	Prices include Packing for Export.
5	18	£11 10 0	£14 0 0	
5	24	17 10 0	21 0 0	
10	18	21 0 0	26 0 0	
10	24	32 10 0	30 0 0	

The ten feet cylinders can be supplied in two halves, for convenience of transit at an extra charge, as follows:—

For the 10 ft. by 18 in.	..	£1 15s. extra.
" 10 ft. by 24 in.	...	£2 10s. "

SMOUT'S PATENT COFFEE PEELER & POLISHER.





		Without Fan.		With Fan.	
Size	...	18 inch.	36 inch.	18 inch.	36 inch.
Price	...	£25 0 0	£45 0 0	£35 0 0	£59 4 0
Packing and Delivery f. o. b. London		1 0 0	2 10 0	1 5 0	3 0 0
Gross Weight	lbs.	336	1,054	432	1,256
Maximum Revolutions per minute	per	120	120	120	120
Capacity per hour	cwt.	2	8	2	8
Packing for Mule Carriage extra		...	1 5 0	...	1 5 0

"This excellent and simple machine has met with the greatest success, and its superiority is proved by the higher prices obtained for coffee which has been treated by it. SMOUT'S PEELER is now considered indispensable and is employed in all the large establishments for the cleaning of Coffee in London, Hamburg and European ports. There are no complicated parts with springs or other contrivances to get out of order, and owing to the strength of its construction no part is liable to breakage or to wear out.

"The working of this peeler is extremely simple. The machine having been put in motion, the parchment coffee is fed into the hopper, when it is only necessary to adjust the weight on the lever of the discharge door and the regulator on the Fan and the Coffee will be turned out with the desired finish. If the machine is properly adjusted, the Coffee will only require to be passed once through it.

"This peeler possesses the advantage, that it can be worked equally well at any power up to its maximum, the quantity of Coffee cleaned being in proportion to the power applied. It works without noise and without creating dust and it is the only machine that does not break a single grain of coffee. We venture to say, that it is also the cheapest Peeler in the world, as no other machine at the same price can produce an equal amount of work.

"We can supply it either with or without the *Exhaust Fan*, as shewn by the above illustrations. By means of the Fan the Coffee is delivered quite clean and fit to be passed at once to the Separator. This arrangement is a very valuable improvement, as it saves not only the time occupied, but also the labour required to carry the coffee to a separate Fan for the purpose of removing the dust and chaff. The Exhaust Fan will be sent to blow in the direction shown in the sketch, unless specially ordered to blow in the opposite direction.

"When more than one machine is required, two or more can be coupled together and driven by one band. This machine can be divided for mule carriage when desired."

The following account of an experiment in planting Liberian Coffee appeared in the *Madras Mail* of 10th May, 1890 and was republished in the *Kew Bulletin* for November, 1890:—

Some 15 years ago I received a couple of Liberian plants from a number presented to a Planters' Association by Government. These had come out to the country, I believe, from Kew direct, in a Wardian case. Planted in a back garden and almost unnoticed and uncared for, they grew broad and high till now they are about 26 feet and have apparently no intention of stopping. In the evil report soon after prevailing regarding Liberian Coffee, I supposed there was nothing in it till at length I began to notice that the trees were bearing very well, and that there was no trace of leaf disease. Then I planted out 200 or 300 seedlings, in a new clearing along with Arabica, and these, now seven or eight years old and in a more sheltered position than their parents, have done even better. Planted 10 by 10 over Arabica they have now ran up to 16 or 18 feet, all exactly of one type, and are bearing exceedingly well; the crop on them for this season cannot well be taken at less than three pounds of clean coffee per tree. The Arabica underneath them has suffered frightfully from fungus regularly every year, yet I challenge any one to find a sign of it on them. A few of the old leaves, turn yellow and tumble off, as was the natural way of our old staple before the days of leaf disease, as I well remember before 1868. We know that Liberian Coffee will grow at the sea-level; the ones above referred to are at 2,500 feet in sheltered bamboo land: whether they will do well at higher elevations remains to be seen, but as far as I can see I am satisfied, and only regret that I did not do eight years ago what I am doing now, viz., plant Liberian all over my clearing with the Arabica and let the best win. To sum up, the points of difference between Liberian and Arabica I find as advantages:—

1. That it does not get fungus, or only in such a way that the health of the trees is in no way affected.
2. That it is a tree, not a bush, running up to 30 feet in height before 15 years old, and in consequence is not injured by drought.
3. That judging by the trees in evidence, and the way they go on growing, and by the fact that they do not come into bearing till four or five years old, this variety may be taken as much longer lived.

4. That it is a heavier bearing tree when once fairly started; those in evidence now yielding 10 to 20 cwts. per acre, calculating on the clean coffee yielded, and admitting that only some 700 trees to the acre can be grown instead of at least double that number of the old kind.
5. That being a deep-rooted plant, it is not affected by drought, while a very slight shower is quite sufficient to bring out and set the blossom; which, moreover, has the further advantage of fading and falling off within the day of its opening, so that it is hardly possible that it can be injured by rain or hail as is so often the case with the delicate Arabica blossom. Even in the very driest season, when the other plants appear on the point of destruction, these look cool and green and not turning a leaf.
6. That the cost of cultivation is comparatively little. There is *no pruning to do* beyond pulling off the suckers for two or three years to prevent the tree from running up into too many stems, the crop is carried on the same wood (and extensions of it) year after year, and there is, therefore, no old wood to cut out. The shade of a thick, tall tree like this, where they pretty well cover the ground would effectually prevent weeds from becoming troublesome, and as the roots are deep down, the debilitating effects of weeds even if they did grow, would be very little felt.
7. The berries (of the size of a walnut) remain firmly fixed on the tree for *many weeks* after they are ripe enough to pick; eventually they fall off, and may be gathered off the ground. In the case of a scarcity of labour this might be an advantage.

Against these good points we may set the following:—

1. That this species gives very little return till at least the fifth year, while in low-lying districts some return is got from Arabica in the second year.
2. That the value in the London market, from a sample lately sent home, is about 10 per cent. lower than that of ordinary coffee.
3. That in districts under the south-west monsoon, whose flowering season is in March and April, the crop instead of beginning to ripen in October and finishing in January or February takes a whole 14 months to ripen. The flowering season is the same as the other, but though some berries will turn ripe in the following April much of it will not be ready to gather until July. Thus the tree carries two crops at the same time, and all mixed together on the same branches. Sometimes at the end of the spring we may see at the same time the crop of the previous season as large as plums, and partially turning red, the crop of the current season the size of peas, and a further sprinkling of the curious eight-petalled, heavily scented blossoms as large as the palm of a child's hand. All these mixed together among the large dark, glossy leaves, give the tree a most rich and handsome appearance.

There are now one or two points about which some information may be of interest.

Picking.—There is no difficulty about this; a notched bamboo enables the coolie to get up among the branches, and he then strips off all that is ripe, or nearly so (taking care not to rip off the small berries), dropping it all on the ground, and collecting afterwards into baskets.

It takes four bushels of these huge cherries to make one of parchment (instead of two as with Arabica), but even so, the fruit being so large, a coolie can pick quite twice as much as of the other, and the cost per ton of clean would be much the same.

Curing.—I have seen advertisements of special pulpers made in Ceylon for Liberian Coffee, and have no doubt that they are as effective as they are represented. Any one growing a quantity of this coffee would have to employ machinery.

I have tried experiments on a small scale with my cherry, and found that it was no use to pass the stuff through an ordinary disc pulper (set of course very wide,) because the husk never (at this elevation) gets soft enough to squeeze out below the chop but rolls up into a hard ball and comes out with the parchment in front; and I found that when the chop was set wide enough to allow the husk to pass, the bean went with it. Moreover the work was so hard that four coolies were completely tired out in pulping two bushels. Then I found that the simplest way of getting at the parchment was to put it up in heaps in the pulping house *to rot*. This may seem barbarous, but the colour of the clean coffee so treated was quite as good as some treated in the ordinary way, indeed the parchment envelope of the bean is so thick and strong that it completely protects it from injury from heating. Moreover this kind of coffee will carry nothing but a dead whitey-green colour no matter how the curing may be done. If allowed to dry in cherry some heavy peeler might perhaps break it up, but it seems to me as hard and tough as the very best road metal and I much doubt whether a coffee curing firm would undertake it on the usual terms. As regards the drinking qualities of this variety, I can safely say that no one who had not previously been told would know that he was not drinking the pukka article, the same quantity of powder goes further and I cannot notice any inferiority of quality. Unsuspecting guests have often said "May I have another cup of this excellent coffee?" and they usually look somewhat surprised when told what it was. If you try to sell it in the bazaar whole and clean (looking something like date stones in shops) natives decline to buy it. "This one kind had 'imitation coffee'" they will say, but if you smash it up and mix a little dirt with it they will take it readily, and never find out the difference.

Planting.—Owing to the seedling throwing out a strong, deep, tap root, something like that of a jack tree, I am inclined to think that when a plantation has to be made it would be better to have the pits made ready by May, and then to put one or more seeds in each pit as early in the south-west monsoon as possible, so that the seedlings may get established before the end of the north-east monsoon in December. But if not grown to any great size they can be lifted with a little special care from nurseries in the ordinary way. Considering the fact that Liberian coffee does not come into bearing till two or three years after the other, it may probably be a wise plan for one going in for its cultivation to pit his clearing 4 by 4 and to plant Arabica, afterwards putting in the giant kind down every other row, making them thus 8 by 8. The Liberian is much too robust to take any notice of its little friend, while by the time it has come into bearing you may safely assume that the Arabica has given what it can in maiden crops, and unless heavily manured has already made arrangements for returning to a better world where there is no fungus.

The *Kew Bulletin* for November, 1892, contained the following account by Mr. T. H. Hill, giving actual figures of results obtained:—

The more important plantations yielding regular crops of Liberian Coffee are established in Java and in the Straits Settlements. In the latter the yield per acre in full bearing is given as ranging from $9\frac{1}{2}$ cwt. to $11\frac{1}{2}$ cwt. per acre. Placing the price of Liberian coffee as low as 90s. per cwt., this would show a gross return of from £42 to £52 per acre. This is a higher return than is obtained from almost any plantations of Arabian coffee.

These figures, it should be remembered, are based on returns supplied to Kew by an experienced and competent planter, and the details are given below.

LIBERIAN COFFEE CROPS FROM ESTATES IN THE PROTECTED NATIVE STATES OF
THE MALAY PENINSULA.

	Produced.	Average per Acre for Years in Full Bearing.
LINSUM ESTATE, IN SUNGEE UJONG— Weedy at times.	Piculs. Cwts.	
In 1884, 28 acres under 4 years old . . . }	84 or 99	
" " 12 " " 3 " " . . . }		
In 1885, 28 " over 4 " " . . . }	312 " 371½	
" " 12 " under 4 " " . . . }		
" " 25 " " 3 " " . . . }		
In 1886, 40 " over 4 " " . . . }	311 " 369	
" " 25 " under 4 " " . . . }		
In 1887, 65 acres of coffee in full bearing . . .	345 " 409½	
" 1888, 65 " " " " " . . .	542 " 643½	
" 1889, 65 acres in full bearing . . .	615 " 732	
" 1890, 65 " " " " " . . .	583 " 692	
	3,316	
Average per acre for 4 years in full bearing S'LIAN ESTATE, IN SUNGEE UJONG— Weedy at times.	.	9½ cwts.
In 1885, 8 acres under 4 years old . . . }	78 or 92	
" " 28 " " 3 " " " . . . }		
In 1886, 8 " " 5 " " " . . . }		
" " 28 " " 4 " " " . . . }	284 " 336	
" " 9 " " 3 " " " . . . }		
In 1887, 36 " " 5 " " " . . . }	208 " 238	
" " 9 " " 4 " " " . . . }		
In 1888, 45 acres in full bearing . . .	417 " 495	
" 1889, 45 " " " " " . . .	396 " 471	
" 1890, 45 " " " " " . . .	409 " 481	
	1,447	
Average per acre for 3 years in full bearing WELD'S HILL ESTATE, IN SELANGOR— Clean.	.	10 7-10 cwts.
In 1886, 19 acres under 4 years old . . . }	274 or 325	
" " 36 " over 4 " " " . . . }		
In 1887, 55 acres of coffee in full bearing . . .	339 " 402	
" 1888, 55 " " " " " . . .	422 " 501	
" 1889, 55 " " " " " . . .	552 " 657	
" 1890, 55 " " " " " . . .	327 " 376	
	1,936	
Average per acre for four years in full bearing BATU CAVES ESTATE, IN SELANGOR— Weedy at times.	.	3 8-10 cwts.
In 1888, 11¼ acres under 4 years old . . .	66 or 78	
" 1889, 11¼ " 5 years old . . .	61 " 72	
" 1890, 11¼ acres of coffee in full bearing . . .	111 " 131	
Average per acre for 1 year in full bearing . . .	.	11½ cwts.

REMARKS.

Crop was lost in 1884, 1885, 1886, and 1887, from want of labour.
The crop on Weld's Hill was thrown back by heavy pruning and unsuitable weather for ripening.

The crops for 1891 will not decrease these averages.

Т. И. И.

SUNGEI UJONG.—LINSUM ESTATE.

Crop from 1st January, to 31st December, 1891.

Area in Acres.	No. of Field.	Date planted.	Age.	Boxes of Cherry.	Clean Coffee in Piculs.*	Yield per acre in Piculs and Catties.	Remarks.
15	1	May to July 1881	11 years	1,085½	111	7.40	
25	2	Early 1880	11 years & 5 months	1,873	200	8.	Very wide planted.
35	3	December 1887, May 1888	4 years & over	197½	21½	.60	Old cacao land planted. Many vacancies.
22	4&5	April to June 1882	10 years	1,760	188	8.50	
18	7	October to November 1888	3 years & over	131	14½	.70	The out-turn is taken on the average where-as on young coffee 8 boxes make 1 picul

* A picul = 133½ pounds.

SUNGEI UJONG.—S'LIA ESTATE.

Crop from 1st January to 31st December, 1891.

Area in Acres.	No. of Field.	Date planted.	Age.	Boxes of Cherry.	Clean Coffee in Piculs.	Yield per Acre in Piculs and Catties.	Remarks.
4	1	In 1882	10 years	233	22	5.75	
9	2	May 1882	10 "	963	96	10.60	
23	3	August 1882	9 years & 8 months	1,376½	138	6.00	
9	4	September 1883	8 years and 7 months	403½	40	4.40	Close planted.

SELANGOR.—WELD'S HILL ESTATE.
Crop from 1st January to 31st December, 1891.

Area in Acres.	No. of Field.	Date planted.	Age.	Boxes of Cherry.	Clean Coffee in Piculs.	Yield per Acre in Piculs and Catties.	Remarks.
65	—	August, 1882	9 years and 4 months	3,614	448.80	6.90	Highly cultivated; but estate surrounded by open country. Chiefly grass.
35	—	October, 1887	4 years and 2 months	989	122.50	3.50	

SELANGOR.—BATU ESTATE.
Crop from 1st January to 31st December, 1891.

Area in Acres.	No. of Field.	Date Planted.	Age.	Boxes of Cherry.	Clean Coffee in Piculs.	Yield per Acre in Piculs and Catties.	Remarks.
11½	—	May, June, 1884	7 years	535	61.20	5.44	Unmanured until 1891.
3½	—	November, 1887	4 years, 1 month	151	17.	5.23	
17	—	June, 1888	3 years, 5 months	321	36.71	2.16	
15	—	Nov. to Dec., 1888	2 years, 7 months	43	4.84	.21	
7	—	October, 1889	2 years, 4 months				

PERAK.—KAMMING ESTATE.
Crop from 1st January to 31st December, 1891.

Area in Acres.	No. of Field.	Date Planted.	Age.	Boxes of Cherry.	Clean Coffee.	Yield per Acre.	Remarks.
30	1	October, 1888*	3 years	735	71.20	51 catties	The full area of each field is given, but owing to failures of first planting, there were not more than 60 per cent. of the original trees, many of which had no crop.
52		November, 1888	3 years, 1 month				
56	2	December, 1888	3 years				

The returns from these Liberian coffee estates are interesting as showing that under favourable circumstances the yield is not showing any tendency to decrease. Linsum and S'Lian, in Sungei Ujong, estates are surrounded by forest, and the atmosphere there is generally laden with moisture (rain-fall from 90" to 120") and rain falling on over 200 days in the year, with heavier and more continuous rains in October, November, and the early part of December. The older fields on these estates are manured yearly, and weeds are allowed to grow and have been for many years for a large portion of the year. At certain times the estates are, for periods varying from six weeks to three months, kept scrupulously clean. The cost of cultivation is from \$70 to \$90 per acre per annum. The soil is not particularly rich, but the climate, from the moisture makes the estates very productive. The export duty of thirty (dollars) cents per picul produces to the Government an equivalent of a quit-rent of \$2 40 per acre, on the land in full bearing.

The younger fields on this estate are finer than the old coffee was at the same age, they all having been planted from selected seed from fine trees, thus getting a pedigree seed, some of the clearings being planted from the 4th generation of seed so selected, and the 5th generation of seed is now in the nursery.

Weld's Hill Estate is in Selangor, and owing to the growth of the town of Qualla Sumpor and its surroundings is in an open plain, so that although the rainfall is much the same, the evaporation is very much more rapid, and the yield of crop is not so large. This may partially be accounted for by the estate being more on the slopes of hills and therefore unsuitable for the growth of weeds. The boundaries of this estate are now being planted with *Inga Saman*, *Albizia moluccana*, and other quick-growing trees to alleviate this dry atmosphere as much as is possible. It suggests itself as a matter of grave consideration for the Governments as to how much the capital of these fertile countries is due to their humid climate produced by the large area of forest, and how much to the soil.

Batu Estate has not been manured until 1891, because the soil was so much superior to that of the other estates as to render it theoretically unnecessary to apply manure. In future the same system will be followed as on the other estates.

Kamming Estate.—The yield is very much decreased, owing to the large number of vacancies in the fields, the full areas of which are given, the supplies here are growing luxuriantly, and in a few years these fields will be regular, and from the appearances of the original planted trees, the climate and the soil, the yield should not be less than that on the older estates.

T. H. H.

SUGAR CANE SEEDLINGS.

In December, 1892, several Sugar Cane seedlings were received from the Botanic Gardens of British Guiana.

The following is a list with descriptions as supplied by Mr. Jenman. The remarks in the last column refer to their growth subsequently in Hope Gardens.

The names mentioned are the parent canes.

Tops of all these except numbers 41 and 100 are available for distribution for one month, on application to Director of Public Gardens and Plantations, Gordon Town P. O.

SUGAR CANE SEEDLINGS.

Canes sent to Hope Gardens December 14th, 1892. Seedlings 1893 replanted.

Number.	Extraction of Juice per cent.	Specific Gravity.	Lbs. per gallon of		Remarks on Growth in Hope Gardens.
			Sucrose	Glucose.	
37	65.6	1.084	1.954	.098	Bad.
41	72.6	1.079	2.014	.055	Dead.
45	66.1	1.092	2.300	.143	Medium.
49	68.4	1.078	1.640	.147	Poor. Upright.
53	68.9	1.077	1.688	.125	Good.
57	70.9	1.078	1.642	.104	Very Good.
61	71.2	1.087	1.944	.056	Good.
69	70	1.085	1.912	.096	Very Good.
74	68	1.090	2.184	.063	Very Good.
78	70.9	1.078	1.722	.080	Poor.
80	66.6	1.087	1.966	.208	Fair.
81	67.8	1.076	1.666	.271	Very Good.
82	63.9	1.094	2.200	.091	Very Good. Upright.
85	71.2	1.085	1.860	.102	Very Good.
95	72.2	1.094	2.228	.048	Very Good.
99	65.9	1.092	2.052	.060	Very Good.
100	73.5	1.076	1.718	.125	Dead.
102	68.8	1.094	2.202	.068	Fair.
105	75.6	1.062	1.177	.380	Poor.
108	62.2	1.080	1.878	.145	Poor.

Seedlings of 1890.

114	Caledonian Queen...	62.4	1.070	1.493	.125	Poor.
115	" " ...	66.3	1.069	1.392	.193	Good. Upright.
116	" " ...	66.3	1.068	1.448	.128	Poor.
128	Striped Singapore...	60.	1.060	1.228	.192	Fair.
149	Seete ...	65.2	1.054	1.536	.151	Good.
220	Mani (Norman) ...	66.9	1.070	1.503	.166	Fair.
269	Horne ...	64.9	1.078	1.725	.125	Poor.
275	" ...	63.9	1.069	1.386	.158	Medium.
282	" ...	66.8	1.071	1.367	.196	Medium.
343	" ...	65.2	1.069	1.317	.238	Fair.
159	Bourbon ...	70.	1.053	.915	.200	Medium.
345		71.1	1.079	1.705	.156	Fair.

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.]

FEBRUARY, 1894.

Vol. I.
Part 2.

COCCIDÆ, OR SCALE INSECTS.—IV.

By T. D. A. COCKERELL, Professor of Entomology at the New Mexico Agricultural College.

(11.) *Coccus cacti*, Linn. (The Cochineal Insect).

Diagnosis.—Female broadly oval, soft dark greyish, living in masses of white secretion. When crushed, the insects shows a fine carmine colour. Antennæ small and inconspicuous, of seven joints.

Food-plants.—As^a is well known, Cochineal is obtained from the cacti of the genus *Opuntia*.

Distribution.—Discovered in Mexico in 1518, but now introduced into Madeira and the Canary Islands, Algeria, Spain, India, &c. In the West Indies, it seems only to be found in Jamaica; I have seen it fairly abundant on some cacti in the Parade Garden, Kingston.

Utility.—It is unnecessary to discuss here the commercial value of Cochineal, or the uses to which it is put, as there seems no probability that the insect will become a source of profit in Jamaica. That it was so in former times, I infer from the title of a paper, "Observations on the making of Cochineal in Jamaica" (Phil. Trans., 1691, pp. 502-3), but I have not had an opportunity of consulting this work.

Destructiveness.—It is a pest of cactus-plants in gardens, rather unsightly than injurious.

Enemies.—In Texas it is destroyed by the larvæ of a moth (*Laetilia coccidivora*), and it is infested by a parasitic fly (*Leucopis bellula*).

(12.) *Margarodes formicarium*, Guhl. (The Ground Pearl.)

Diagnosis.—The female insects are found in the ground associated with ants; they are rounded, almost pearl-like in appearance, yellowish, slightly hairy, with small antennæ.

Distribution.—Found in Antigua; also recorded as from the Bahamas, but I think in error.

Destructiveness.—Where abundant, it may injure the roots of cultivated plants, but I have seen no record of its doing so.

(13.) *Lecanium hesperidum*, Linn. (The Common Shield-Scale.)

Diagnosis.—Scale brownish or yellowish, oval in outline, somewhat convex, smooth and more or less shiny. The young are produced alive.

Distribution.—This is perhaps the most widely distributed of all scale insects, the distribution having been brought about, of course, by human means. In the West Indies, it occurs in Kingston, Jamaica; elsewhere it is known from Mexico, the United States, Europe, South Africa, Chili, Australia and New Zealand.

Food-plants.—As might be expected from its distribution, its food-plants are various. In Jamaica it has been found on mango, an orchid (*Stelis* sp.) and *Hippeastrum equestre*. In other countries, on orange, ivy, rose, myrtle, &c.

Destructiveness.—Although well known as one of the more injurious scale-insects elsewhere, it appears to be rare in the West Indies, and of little economic importance. Why this should be, it is hard to say; it cannot be that it does not flourish in the tropics, as at Vera Cruz, Mexico, it appears to do very well.

Enemies.—In the United States it has several Chalcidid parasites, namely *Coccophagus lecanii*, Fitch, *C. cognatus*, How., *C. vividus*, How., *C. flavoscutellum*, Ashm., *Encyrtus flavus*, How., *Eucomys bicolor*, How., and probably others. According to Prof. F. M. Webster, *E. flavus* is especially efficient in keeping it in check.

(14.) *Lecanium terminaliæ*, Oekl. (The Broad Shield-Scale.)

Diagnosis.—Somewhat over $\frac{1}{2}$ inch long, very similar to *L. hesperidum*, but broader in proportion to its length, and ornamented with radiating blackish bands. For fuller details see Journ. Inst. Jamaica, Vol. 1, p. 254.

Distribution.—Known from Kingston, Jamaica, and Vera Cruz, Mexico. Specimens may be obtained in the Marine Gardens, Kingston.

Food-plants.—In Jamaica on the so-called almond (*Terminalia*); in Mexico on a liliaceous plant not identified.

Destructiveness.—Not at present known as a seriously harmful species, but may become so; as the great difference between its two known food-plants indicates that it will very likely feed on a variety of things like *L. hesperidum*.

(15.) *Lecanium longulum*, Dougl. (The Long Shield-Scale.)

Diagnosis.—It resembles *L. hesperidum*, but differs from it in the opposite way from the last, being longer in proportion to its breadth. It shows radiating blackish streaks, much as in *L. terminaliæ*.

Distribution.—Originally found on hothouse plants in England, but apparently a native of the West Indies. It occurs in Jamaica and Antigua, and Mr. Maskell records what he considers to be the same species from the Fiji and Sandwich Islands.

Food-plants.—Very various, *Acacia*, *Anona*, *Myrica*, *Averrhoa*, *Spathophyllum*, &c. Mr. Barber found it infesting pigeon peas in Antigua. Mr. Newstead sent me specimens from *Euphorbia* in an English hothouse.

Destructiveness.—Apparently a rather serious pest in the West Indies, and from its almost omnivorous habits, liable to become more so. It is, however, a most singular thing with regard to this and the last

two species, that they do not occupy all their known food-plants in each locality, though the plants in question may abound. It appears, in fact, that there are different colonies of individuals, differing in food-preferences, though in no ascertainable structural characters.

Enemies.—A Chalcidid parasite, kindly identified for me by Mr. Howard as belonging to the genus *Eupelmus*, was bred from some of the scales on pigeon-peas, received from Antigua.

(16.) *Lecanium rubellum*, Ckll. (The Little Red Shield-Scale.)

Diagnosis.—Of the same general form as *L. hesperidum*, but smaller, and of a brownish-crimson colour. It might easily be taken for the young of some species.

Distribution.—Only known from Petersfield, Jamaica, where it was discovered by Mrs. Swainson.

Food-plant.—Found on the bark of a plant not identified.

Destructiveness.—Probably not very injurious.

(17.) *Lecanium mangiferae*, Green. (The Triangular Shield-Scale.)

Diagnosis.—Greenish, very flat, broad-pyriform or more or less triangular. Examined with a microscope, the hairs round the margin are seen to be branched.

Distribution.—Originally described from Ceylon; now known from British Guiana and Jamaica.

Food-Plants.—It is found on leaves of mango, *Jambosa*, and cinnamon.

Destructiveness.—Not sufficiently abundant in the West Indies to do much damage.

(18.) *Lecanium tessellatum*, Sign. (The Tessellated Shield-Scale)

Diagnosis.—Somewhat over $\frac{1}{2}$ inch long, very flat, broad-oval in outline, dark chestnut-brown, shiny. The skin of the back, examined with a lens, is seen to be tessellated.

Distribution.—Originally found on *Caryota* in a European hothouse. Mr. Maskell reports it from Australia, and it occurs very rarely on leaves of the *lignum-vitæ* in Kingston, Jamaica.

Food-plants.—*Caryota*, *lignum-vitæ* and *Laurus*.

Destructiveness.—Not a serious pest.

Enemies.—A specimen found in Jamaica shows a hole through which a parasite had escaped, but the parasite itself is still unknown.

(19.) *Lecanium assimile* var. *amaryllidis*, Ckll. (The Amaryllis Shield-Scale.)

Diagnosis.—About $\frac{1}{2}$ inch long, oval or oblong in outline, convex, shiny, black with a pale margin, or brownish. The margin is finely radiately wrinkled.

Distribution.—Only known from Antigua, where it was discovered by Mr. Barber. It is believed, however, to be a variety of *L. assimile*, Newst., which was found on *Grindelia* in England, under circumstances which led to the conclusion that it was not a native of that country.

Food-plants.—*Amaryllis* sp.

Destructiveness.—Probably tolerably harmful in gardens.

Enemies.—Several specimens show parasite-holes, but the parasite has not been found.

Las Cruces, N. Mexico, U. S. A., Nov. 25, 1893.

A USEFUL FORAGE PLANT.

POLYGONUM SACHALINENSE.

From "Gardeners' Chronicle" and "Garden."

In the protracted drought of the present season it may, perhaps, be permitted to horticulture to come to the aid of the farmer, just as, twenty-five years ago, the gardener's art helped the Vine-grower out of his difficulties by showing him how to make use of the remedy of grafting.

The remedy in the present case is a robust and vigorous-growing perennial plant, which is equally unaffected by excessive heat in summer and extreme cold in winter, namely the Sachalin Knot-grass (*Polygonum sachalinense*), belonging to the same natural family as the Sorrel, the Buckwheat, the Rhubarb, &c.

Since its introduction into France we have been growing this plant merely as an ornamental subject in gardens, although its young shoots when blanched are as edible as Asparagus, if not of quite so high a quality, and the fine foliage might be utilised in garnishing desserts, and also in packing fruit for market. We certainly had pointed out to bee-keepers the fact that its flowers, which are produced in great abundance, are much frequented by bees at the close of the summer,—but the writings of M. Doumet-Adanson on the qualities of this *Polygonum* as a forage plant which were brought under the notice of the Academie des Sciences by M. Duchartre, and the reports which we have made on the same subject to the National Agricultural Society of France have brought the plant more prominently into view and claim for it the earliest attention of the farmers.

This Sachalin Knot-grass was discovered by the Russian botanical explorer Maximowicz in the Island of Sachalin (or Saghalien) which is situated in the Sea of Okhotsk, between Japan and Siberia.

This island is of large size, and was ceded to Russia by Japan in exchange for the islands of the Kurile Archipelago. In the year 1869 my friend M. Edouard André, meeting with this lately arrived plant in the Jardin d'Acclimation at Moscow, was struck with its highly ornamental character, and brought back specimens of it to France. In speaking of it to us he dwelt very strongly on the great vigour of the growth exhibited by the plant both at root and at top, the roots sending out horizontally on all sides rhizomes which are capable of penetrating the stiffest ground, even that of old, well trodden road-ways, and pushing up fresh shoots in all directions, thus largely extending the area occupied by the plant when first put in the ground. The stems, which are numerous and grow close together soon attain a height of 2 feet or more; even when the early frosts may have nipped their extremities, from the middle and top of the stems issue long, slender, curving ramifications. The foliage is pleasing in its effect, the leaves being alternate, distichous, oblong-oval in shape, each leaf measuring from $1\frac{1}{4}$ to over $1\frac{1}{2}$ inches in length, and about an inch in width. The leaves are also perfectly smooth, or without the least trace of down or tomentum. The leaf stalk is of a carmine-red colour, and the stem, as it ripens, takes on a reddish tinge on a green ground. The flowers which are of a dull white colour, are borne in small axillary clusters, together forming long panicle, closely se

fascicles, which droop slightly with their weight. The bees frequent these flowers in the autumn, but it must be borne in mind that when the plants are regularly cut for forage, there will be no flowers.

The experiments carried out at Baleine are quite conclusive on the subject of forage. A young plant when planted out does not take long to cover an area of a yard square or more with its leaves.

The first cutting is made when the stems have grown from 3 feet to 5 feet high, and if the second growth of the first year is strong enough, a second cutting is then taken. In the following years three or four cuttings are taken annually. In the green state the weight of the grass varies from 44lbs. to 88lbs. per square metre, so that the yield per acre of green fodder would amount to from about 60 tons to 120 tons, according to the calculations of M. Doumet. Horned cattle are very fond of this green fodder.

M. Édouard André, M. Gustavus Hout (president of the Comice Agricole de l'Aube) and some farmers have made trial of the plant with similar satisfactory results.

As the Sachalin Knot-grass does not yield seed here, we propagate it very readily by divisions of the rhizomes, and in this way we have raised thousands of plants for distribution amongst agricultural schools and to enable us to meet the demands for it which reach us daily. The proper time for planting it is in August and September or else in spring. Any ordinary soil will suit it,—however, a moderately moist position would help to retain the sap and be conducive to obtaining a leafy final cutting at the close of the season. After planting, no further cultural attentions are required, and the plant may be left entirely to itself during the winter, whether this may turn out dry, or damp or snowy. In the ensuing spring any stems that remain standing should be cut away before the new growth pushes. At planting time, if the plants are set out a metre (3 feet 3 inches) apart in every direction, the surface of the soil will soon be covered with an abundance of nutritious forage.

CHARLES BALTET, Troyes, France.

NOTES ON GRAPE VINES.

By W. THOMPSON of the Department of Public Gardens and Plantations.

All vines that were not pruned in the Autumn should be pruned now. If the vines are in a fit state to prune, the leaves will have fallen off; the past season's growth should have become hard and of a brown colour. The pruning should be done at once or by the middle of March.

One year old vines intended for field culture should be kept to one stem and this cut back to within six inches of the ground.

Young vines growing on arbours or trelliswork can be cut back to about two feet from the ground as there is nothing gained by forming too much main stem at one time.

Old vines fit for pruning should have all thin and under-growths cut off, then the new wood cut back to just above a plump bud about two inches from the old wood or main stem. The fruiting spurs must not be left closer than twelve inches apart. There must not be too many old stems left in, or the foliage will be too thick when the vines begin to

grow. The ground about the vine should be dug about eighteen inches deep and well manured, but the roots of the vine must not be disturbed.

The vines should have a good soaking of water about a week after pruning them; after that they should be kept well supplied with water.

Vines must be given all the sun possible as the least shade is most injurious to them.

MILDEW ON PEAS.

When at Rusham Park, Oxfordshire, at the end of last summer, I was much struck with some lines of Ne Plus Ultra Peas, which appeared to be entirely unaffected by mildew at a season of the year when this variety is often much subject to it. I found that Mr. Wingrove, the gardener, immediately upon the mildew putting in an appearance, dusted the soil about the roots and the lower part of the foliage with soot, with the result that the spread of the mildew was at once checked. While the Peas were manured by the soot being placed upon the soil, Mr. Wingrove stated he always found soot to be an unfailing remedy against the mildew.

(*Gardeners' Chronicle*.)

FORESTRY.

THE STORY OF HAWAII'S DEPARTED FORESTS, VERDURE AND RAINS.

Reprinted from "The Planters' Monthly," Honolulu.

On the Mahukona side of Hawaii, one can travel for miles near the sea, through evidences of comparatively recent human habitation, and find no human inhabitant. Innumerable enclosures that stand side by side like village lots, are said to have contained not long since, each a house and family. History tells of a dense population here. But it has melted away, as though a deluge had swept them and their belongings from the earth. Nothing remains but the stone fences; and even these are fast being levelled, and their constituent rocks scattered over the desolate waste.

And the wonder is,—not why people went, nor where they went, but why they ever came to build their homes in this barren place.

To look at this stony desert, it seems incredible that not so very many years ago, there were trees growing here, and meadow land, and welling springs of water and vines and flowers and fruits. Not a spot of bloom and not a stump of forest tree remains—nothing but the brown earth and the rocks. A mile up the hillside, there is grass brown at first, and by degrees changing into green; and miles away on the distant hills, a suspicion, perhaps, of foliage. But here there remains but the shadow of the substance that has disappeared. Men come and go at their own sweet will as the world well knows. But, what volcanic disaster, what whirling tempest, fell upon the forest and the meadow life, and robbed the fruitful earth of its mantle of green?

The destruction began so insidiously, it was hardly noticed at first. Herds began to multiply upon the hills. Cattle and goats browsed upon the tender leaves of young plants in the forest glades. As old trees died, there were none to grow up in their places. Fire sometimes followed in the cattle's track. The water from the springs in the forest depths, was sucked up by the bare and thirsty soil, miles be-

fore it reached the sea. The rainfall ceased. The foliage of the lowlands withered. And the land that once was fitted to be the abode of man, became a desert waste.

For all the purposes of desolation, the patient plodding cow, aided and abetted by man, has proved herself more dangerous than the elemental forces of nature. On the average each year, she can sweep through five acres of forest land more destructively than a cyclone. What wonder that the agricultural Egyptians fell foul of the pastoral Hebrews, and set them to making bricks without straw upon the lands their herds had laid waste!

In the plantation district the trees have been cleared away, that cane might be planted. And vast quantities of wood have been used for fuel. The time was when cane juice was boiled into sugar in open train over wood fires. So all the lowland has been shorn of its trees, and the forest belt in these more fertile parts is each year becoming more distant.

All through North Kohala near the sea, the rainfall is not only much less than in former years, but it is also capricious. Its coming is so very uncertain that its uncertainty has become proverbial. Streams that once ran all the year, now run only for a few months or even weeks. Other streams that start promisingly from the distant hills dry up and disappear long before they reach the sea.

There may be cosmic influences that disturb the rainfall from time to time. But there seems no doubt that the rapid destruction of the forests has been the main cause of our lack of moisture. And the work of destruction is still going on. The cattle and other animals still continue their desolating inroads upon the timbered lands and the forest belt is still retreating.

Here and there a land owner is making a tentative experiment in the planting of a little grove of trees. And here and there a rancher is making some effort to fence in and save the timber still remaining. But unless the Government will offer some assistance, or at least, systematize the work, the damage will undoubtedly increase as the years roll on.

J. BARNETT.

Kohala, August, 1893.

STRAWBERRIES ON VARIOUS SOILS.

Unlike market growers, private gardeners have difficulties to surmount in the cultivation of Strawberries which the former are not likely to have, and that is in the nature of the soil. A grower for market on a fairly large scale will not attempt the cultivation of this fruit unless the soil should be suitable whereas the private grower has to provide Strawberries whatever the soil may be. The methods of the private grower again are also often ridiculed, such for instance, as the trouble taken in the preparation of the soil, and which the market grower may think quite unnecessary. The market grower, again, grows but one or two varieties, and such as are known to succeed well in the soil or district, but the private grower has to maintain a succession as long as possible, consequently varieties have to be grown which would not thrive well with the market grower under the rough-and-ready method of field culture. I am ready to admit that in many instances a lot of unnecessary trouble is undoubtedly taken in the

matter of trenching, but if quite unnecessary in some instances it is not in others. as I have met with cases where it was quite impossible to cultivate Strawberries successfully unless some form of trenching was adopted. The past season has been evidence of this, as in the majority of cases where the plants collapsed at the time when they should have been producing fruit it was on account of there not being a sufficient depth of worked and fertile soil. It is in such cases as this that an extra depth of soil must be provided, and this either by trenching if the soil will admit. or by bastard trenching if the sub-soil is not in a condition to enable it to be brought to the surface. The most successful instance I ever met with of Strawberry culture on a light and thin soil was at Loxford Hall, where Mr. Douglas produced some of the grandest crops I ever met with. His system was to plant annually. The soil in the first instance was well trenched, working in at the same time a good dressing of cow manure, healthy young plants which had been layered early in 3-inch pots being set out in the latter part of July or during the early days of August. In no instance were the plants allowed to remain longer than one year, in fact, it was useless to allow them to remain longer, as if so, they would degenerate and do but little good. Now here was a very successful instance of good crops of Strawberries being produced annually and this in soil in which it was thought it would be useless to attempt the cultivation of the Strawberry with any degree of success.

Trenching alone will not ensure success, as much depends upon the kind of plants and the manner of planting them. Those produced from yearling plants are much the best, as when runners are taken from older plants they are not nearly so satisfactory as these, besides being small are not in a condition to make a satisfactory growth. The planting may also seem a simple affair, but it requires to be done with care in order that, the plants may take quickly to the soil and soon become established. In the first place the surface should be made as firm as possible. When ready for planting a little fresh soil should also be at hand for placing around the balls. Not but that the plants will take to the soil without this fresh addition, but on poor or unkindly soils it gives them a start, and the results obtained will repay for the trouble taken. I use old potting soil with burned refuse, with an admixture of fresh soil if it can be spared. A spadeful is sufficient for each plant. This must be pressed well around the ball, leaving also a shallow depression around the plant as a receptacle for water. On heavy land trenching is not needed, in fact, I am sure the plants succeed better without it. These soils never have a hard sub-soil, neither do the plants suffer to the same extent from want of water. A hard impervious clay, or such as have not been brought under cultivation, will of course require improving by the addition of road grit, burned soil, burned garden refuse, or anything of a like nature. But I refer to heavy land or such as has previously grown good vegetables. All that I find necessary to ensure the plants succeeding well is to fork over the soil to the full depth of the fork, working in a good dressing of manure and burned refuse. The system of planting is the same as on light or gravelly soils. Trenching such soils as these, besides being quite unnecessary would I am sure, not lead to successful results. Medium soils are the better for being bastard trenched.—(*The Garden.*)

SUGAR-CANE DISEASE.

EXTRACT from *Kew Bulletin*.

REPORT on "ROOT DISEASE" of SUGAR-CANE from BARBADOS.

By GEORGE MASSEE, Royal Gardens, Kew.

The stools of sugar-cane sent to Kew by Mr. Bovell from Barbados, for the purpose of ascertaining the cause of the "root disease," arrived in excellent condition for that purpose, and an examination of them demonstrates conclusively that the disease is due to a parasite fungus known as *Colletotrichum falcatum*, Went. The fungus cannot effect an entrance through the unbroken surface of the stem of the sugar-cane. But the conidia germinate on decaying lateral shoots, or the ragged base left by fallen leaves. Its entrance into the living portion is indicated by a bright red coloration of the fibro-vascular bundles, the colour subsequently extending to the ground tissue.

When an entrance has been effected the hyphæ spread rapidly throughout the length of the cane, and after a time the fructification ruptures the epidermis in the neighbourhood of the joints, and appears on the surface as a more or less effused, black, minutely velvety patch.

Microscopic examination shows the velvety appearance of the fruiting patches to be due to the presence of numerous rigid, dark-coloured hairs, springing from a dense basal web of colourless hyphæ; these latter also bear large numbers of minute, colourless conidia, or reproductive bodies. The conidia are capable of germinating the moment they are mature, and being produced quickly and readily disseminated, easily infect neighbouring plants.

A second kind of conidia are formed on the oldest portions of mycelium present in the tissues, two or three large globose conidia being frequently found on the hyphæ present in a single cell of the cane. These internal conidia can only escape when the cane in which they exist has become thoroughly decayed. The fungus, under normal conditions, attacks the above-ground portions of the cane, the "root disease" condition being a modification of the normal form, called into existence by the method of cane cultivation adopted.

A careful examination of all the canes forwarded shows that the portion buried in the ground contains much more mycelium than that above ground; the mycelium in the root is also more mature, frequently producing enormous quantities of conidia in the cells. In some instances the root was rotten and decayed, the disintegration being effected by the fungus; nevertheless there is not the slightest evidence to favour the idea that the disease originated *after* planting. Many of the small roots contained a large quantity of mycelium, but it was evident in every case that this had passed from the stock into the root. On the other hand, everything points to the conclusion that the portions of the cane used for propagation already contain the mycelium of the fungus, although its presence may not be indicated externally, and that the mycelium present in the buried portion of the cane, favoured by darkness and moisture, develops at an abnormal rate, thus assuming the character of a disease, which in its intensity is foreign to the fungus when developing under normal conditions. Two additional species of fungi, not in any way connected with the disease, were common on fading leaves of the canes; the one, a species of *Chaetostroma*,

the other a *Botrytis*. The last mentioned was also found on canes sent previously by Mr. Bovell, and it was suggested at the time that it might be connected with the disease. But further investigation has not in any way confirmed this; the *Botrytis* may for the future be dismissed from consideration.

The sugar-cane disease in Java, called *Rood Snot*,* is apparently the same thing, and it would be interesting to ascertain if this is the source from which it has been introduced into the West Indies.

Summary.

The disease is caused by a parasitic fungus called *Colletotrichum falcatum*, Went., and the evidence points to the injudicious use of diseased canes for propagation as the cause of the injury to the crop which is now experienced.

Preventive Measures.

1. All diseased canes should be burnt and not allowed to decay naturally.

2. Perfectly healthy canes should be used for propagation, and to secure this, the canes should be obtained from an area not infected with the disease.

3 Mr. Bovell, in a letter addressed to Kew, says:—"I have managed to stamp out the disease here by growing other crops on the fields attacked, for a year or two." This is a very essential point, as the litter of the cane leaves, &c. on the ground will be infected with the fungus, and perfectly healthy plants would be attacked if planted at once on an infected site.

4. There is reason to think that if perfectly healthy and uninfected canes were only used for propagation, the disease would not be found to give much trouble.

EXTRACT from LETTER from DIRECTOR OF ROYAL GARDENS, KEW.
3rd November, 1893.

The disease is totally distinct from that which was the subject of my letter of April 5 last. It is practically identical with one which exists in Java, from which it is not improbable that it has been introduced.

It is evident that the weak point in sugar-cane cultivation in the West Indies is the want of care in the propagation of the canes. The very finest and most healthy canes should be scrupulously selected and set apart for the purpose. Unfortunately, any weakly or even diseased canes appear to be thought good enough. Apparently, in consequence of this short-sighted practice, a disease, which under ordinary circumstances would have been of little moment, has assumed troublesome dimensions.

It appears to me that the cultivation of the sugar-cane generally in Barbados is not prosecuted with much intelligence. The outbreak of disease in a cultural staple is not always to be looked upon as simply "the act of God," but is often aggravated, if not actually produced, by the neglect of reasonable precautions.

I long ago pointed out, and it is now beginning to be understood, that an immense deal can be done for the improvement of the sugar-cane by the continuous selection for propagation of the best possible

* Het *Rood Snot*: Dr. Went (H. van Ingen Soerabaia, 1893).

canes. Not merely should this be done systematically on individual estates, but it should be carried on at the Botanical Station. In the latter case, the canes should be systematically analysed in order to select those canes which are richest in sugar.

In this connexion, I am sorry to learn from Mr. Bovell, in a letter which accompanied the specimens of diseased canes, that nothing has been done with regard to the provision of a larger experimental station. A committee appears to have been appointed by the Legislative Council to consider the matter and was allowed to lapse without reporting.

In conclusion, I must point out, that, though Kew may be able to be of some assistance in technical matters like the present, it cannot supply the cultivator with the energy and intelligent resource, without which no industry in the long run can be successfully prosecuted.

EXTRACT from *Barbados Bulletin*, December 12, 1893.

After the repeated warnings which our planters have received from the Kew authorities respecting the prevalent cane diseases and the necessity of being careful in the selection of seed, or cane plants, many of our planters are still pursuing the old and irrational methods of selection that have been condemned by those who speak authoritatively on the subject. While passing through several estates last week, we witnessed the process of collecting and selecting cane sprouts for planting, and on carefully examining their quality, in order to ascertain if sufficient attention had been given in their selection, we found on one estate (managed by one of the oldest, most experienced, wealthiest and respected planters in this island) that a large quantity of plants had been purchased from labourers on the estate who had grown small, stunted, sickly-looking canes on the poor patches of soil around their huts, and it is from these stunted canes the sprouts had been taken. On another estate we saw plants selected for sowing that had the rind fungus on many of them, which the unscientific overseer assured us would be destroyed in the process of soaking in lime-water before planting; and on a third estate, one of the largest in the island, we saw a great heap of plants, many of which on examination were found to be attacked with the borer. Here, then, were men boasting of their experience as planters, who were engaged in propagating disease by sowing the very evils against which they profess to be contending. A more suicidal policy could not be imagined. And on asking one of these agricultural wise-acres why such poor seed had been selected, and why a nursery of strong, healthy canes had not been established on the estate for the purpose of supplying it with good, vigorous seed plants, he replied that they could not afford to divert sufficient land for the purpose, and that it was cheaper to buy sprouts from the labourers than to grow them as we had suggested. Some, indeed many, of our planters are annoyed because Mr. Thiselton-Dyer has laid the blame of the prevalent cane-pests at their door; but if his statement needed any vindication, that the planters are themselves largely responsible for the evils that exist through their neglect of necessary precautions and their carelessness in selecting cane plants, that vindication the planters are themselves supplying by following the condemned customs of the past and recklessly pursuing a course that can only tend to the perpetuation and increase of the evils they profess to be anxious to avert.

FERNS: SYNOPTICAL LIST.—XXV.

Synoptical List. with descriptions of the Ferns and Fern-Allies of Jamaica, by G. S. Jenman, Superintendent Botanical Gardens, Demerara, (continued from Bulletin No. 49, Old Series.)

24. *Asplenium Serra*, Langsd. & Fisch.—Rootstock repent, woody, densely clothed with fine reticulated dark scales; stipites tufted, strong, erect, $\frac{1}{2}$ –1 ft. l. brown or dark, naked or puberulous; rachis similar, channelled, sparsely deciduous on the upper side; fronds pinnate, coriaceous, glabrous, dark cloudy green, glossy above, pendent or prostrate, 1–2½ ft. l. $\frac{3}{4}$ –1½ ft. w. not reduced downwards, the acuminate apex lobate-serrate; pinnæ horizontal, subdistant, 4–8 in. l. $\frac{3}{8}$ –1 in. w. numerous, base stipitate and obliquely cuneate, broader on the superior side, gradually tapering outwards to the long linear-acuminate often much attenuated end; margins incised and lobate-serrate, the teeth usually grouped, becoming gradually single and distant in the outer part; veins twice or thrice forked, very acutely long-curved; sori about $\frac{1}{2}$ in. l. forming a continuous series close against and almost parallel with the midrib; involucre narrow, fragile. *A. erosum*, Sw.

Infrequent in forests from 4,000–6,000 ft. alt. chiefly on the higher ridges and peaks; distinguished by the parallel costal lines of sori, and its larger size amongst allied species. Occasionally an attempt is shown to form a second line of sori on each side, but oblique to the primary normal lines. Small forms, only a few inches high, fully fertile, have been gathered at lower elevations, in St. George's, Portland. The serration is interrupted in groups in the larger states, and evenly uniform in the smaller.

25. *A. bisectum*, Sw.—Rootstock elongated, woody, sub-repent, densely clothed with small acuminate, reticulated dark scales; stipites sub-tufted, rather slender, 4–8 in. l. dark glossy brown, rachis similar, slender, fragile, channelled, slightly ciliated at first; fronds pinnate, pendant or prostrate, 1–2 ft. l. or more, 4–6 in. w., not, or hardly at all, reduced at the base, tapering at the top to the inciso-serrate linear point, light bright yellowish-green, glabrous, stiff; pinnæ sub-horizontal, 20–60 or more to a side, apart, the lower sub-distant, or distant 3–4 in. l. 4–6 li. w. base stipitate and obliquely cuneate, deeper on the superior side, tapering outward to the finely attenuated end, incised and serrato-lobate, the teeth sharp, grouped within, gradually becoming single and distant in the outer part; veins very oblique, forked; sori $1\frac{1}{2}$ –2 li. l., a like space apart, close to and in line with the costa, on each side of which they alternate; involucre thin narrow.—Hook. Sp. Fil. Vol. 3. t. 192.

Infrequent in forests above 5,000 ft. alt. chiefly on the slopes of the highest ridges, in peaty soil or leaf-mould and in the forks or on branches of trees; a very fine species, but the very slender rachises are so brittle, though stiff that the larger fronds are rarely found unbroken. The pinnæ are similar in form and arrangement of the sori to those of *Serra* but are much smaller and of a beautiful light bright yellowish green colour. The margins have a very jagged aspect.

26. *A. præmorsum*, Sw.—Rootstock short, woody, erect or oblique, very densely clothed with blackish fine reticulated scales; stipites tufted, erect, 6–9 in. l., at first densely tomentose, later nearly or

quite naked ; rachis similar ; fronds lanceolate-oblong, bi- or tripinnatifid, $\frac{3}{4}$ –1 $\frac{1}{2}$ ft. l. 2–4 in. w., acuminate the base truncate, firm, naked, or the ribs beneath ciliate, dark green and glossy above, pale and striated beneath ; pinnæ numerous, sub-distant, horizontal or oblique, ovate-lanceolate, obtuse or acuminate, 1–3 in. l. $\frac{3}{4}$ –1 $\frac{1}{2}$ in. w. stipitate and broadest at the base, no distinct midrib, cut nearly to the centre into few sub-distant oblique segments, the inner of which on the superior side is cuneate and externally toothed or incised or sub-digitate-cuneate, the opposite, under-side, void of a corresponding segment, the others usually linear-oblong, truncate and sharply toothed or eroded at the end, the sides plain and even ; veins close, parallel or flabellate ; sori parallel or radiant, copious, $\frac{1}{2}$ –1 in. l. straight, involucre narrow, pale. Plum. Fil. t. 98. Hook and Grev. Icon. t. 189. *A. furcatum* Thunb.

Common on rocks and banks in open and sheltered situations between 4,000–6,000 ft. alt ; variable in form, but with no ally of near likeness. It is an almost cosmopolitan species, being spread through nearly all tropical and sub-tropical regions of the world. Though Thunberg's name is usually used, the Swartzian name is the oldest (1788), and was moreover founded on Jamaica specimens.

27. *A. cuneatum*, Lam.—Rootstock erect or decumbent, shortly elongated, densely clothed with fine dark reticulated scales ; stipites tufted, 4–9 in. l. channelled dark grayish, naked or puberulous, base slightly scaly ; rachis similar ; fronds bi-tripinnate, $\frac{3}{4}$ –1 $\frac{1}{2}$ ft. l. 3–8 in w. ovate-lanceolate or lanceolate, acuminate, base truncate, firm, naked, dark green, glossy, pale beneath ; pinnæ numerous, usually horizontal, 2–4 in. l. 1–2 in. w., much the shape of the frond, stipitate, approximate or sub-distant, usually bi-pinnate at the base or lower two-thirds ; pinnulæ apart, stipitate, the larger pinnate ; final segments 4–5 li. l. 2–3 li. b. entire or lobed, spathulate-cuneate, the outer edge rounded and dentate ; veins forked, radial ; sori radial, 1–2 li. l. reaching the marginal teeth ; involucre pale, narrow.—Sl. t. 46. f. 2. Pl. t. 41.

Frequent on trees, logs and rocks in peat or decayed wood or leaf mould in woods and forests from the valleys of the lower hills up to 2,000 ft. alt. A much more compound plant than *præmorsum*, with the segments narrowed in all cases to a distinctly stipitate base, but with no distinct midrib, and the largest being on the superior base, the opposite inferior side being void of a corresponding one.

28. *A. auritum*, Sw.—Stipites slender, tufted from a small upright, brown-scaly fibrous rootstock, 4–6 in. l. gray-green, naked ; rachis similar, channelled, flattened upwards ; fronds pinnate or bi-pinnatifid 6–10 in. l. 2–4 in. w. acuminate, base truncate, pale clear green, naked, variable in texture ; pinnæ spreading, opposite or attenuate, sub-distant, petiolate, 1 $\frac{1}{2}$ –2 $\frac{1}{2}$ in. l. $\frac{1}{4}$ – $\frac{3}{8}$ in. w., base broadest and usually obliquely cuneate, with a single free enlarged ovate or lanceolate segment on the superior side, beyond which both margins are serrato-entire or inciso-lobate, the inferior base cut away, tapering outwards to the acute, acuminate or sometimes attenuated end ; veins pinnate, once or twice forked, running into the marginal teeth ; sori. 1–1 $\frac{1}{2}$ li. l. very oblique, sub-parallel with and medial between the midrib and margin, the same in the basal pinnule ; involucre pale, silvery.—Sl. t. 33. f. 1 and 2.

Var. *A. macilentum*, Kunze.—All parts stronger, stiffer, thicker, rachis margined, $1\frac{1}{2}$ li. w.; pinnæ subentire lobed or pinnatifid on both sides at the base; segments ovate; sori abundant, more divergent from the midrib.—Pl. Fil. t. 46.

Var. *A. rigidum*, Sw.—Resembling the type in texture, &c., but pinnæ pinnato—pinnatifid on both sides within.—*A. longipinnatum*, Tourn.

Var. *parvulum*, Jenm.—Fronds half the size, pinnæ inciso-serrate or pinnatifid, cuneate and equilateral at the base.

Common in woods and forests and more open places, on trees, decaying logs and on rocks from the lower hills up to 5,000 ft. alt.; highly variable, of which beside the varieties described there are numerous well marked forms. The pinnæ vary from quite entire and equilateral to deeply pinnatifid or fully pinnate, the commonest form perhaps being that which is freely serrated and having a single free lobe on the upper interior base. The texture varies as much as the form. Though easily recognised in any of its forms, the more compound clearly connect it with *fragrans*. The plants spread into wide masses by means of viviparous buds on threads or fibres from the rootstock.

29. *A. fragrans*, Sw.—Stipites erect, gray-green, channelled, 3-6 in. l. naked, tufted from a small upright scaly rootstock; rachis similar; flattened in the upper part; fronds ovate-lanceolate, bi-tripinnate, 6-10 in. l. 3-5 in. w. broadest at the base, very acuminate, chartaceous, light green, naked, highly fragrant; pinnæ spreading obliquely, the shape of the fronds, lower petiolate and usually larger, 2-3½ in. l. 1-2 in. w.; pinnulæ lanceolate, stipitate, lobed or fully pinnate on both sides, the largest ¾-1 in. l. ¼-½ in. w. situated on the superior base; final segments ovate-oblong or lanceolate, 2-4 li. l. 1-2 li. w. sharply dentate round the outer part, and also the sides of the larger ones, acute, base cuneate; veins pinnate in the larger, once or twice forked in the smaller segments; sori 1-1½ li. l. on one or both sides of the midveins of the segments, and sub-parallel therewith; involucre pale, thin.—Hook. and Grev. Icon. Fil. t. 92.

Var. *A. faniculaceum*, H. B. K.—Fronds tripinnate, finely cut, the ultimate segments narrow, linear. *A. delicatum*, Pr.

Frequent in forests and sheltered, moist situations on logs and stones, especially near streams, from 2,000-5,000 ft. alt. As mentioned under *auritum*, the simply bipinnate forms of this species are not very clearly marked from the most compound state of that. Generally, however, this is well distinguished by its more multifid state, and the sweet fragrance it emits in drying. The var. is most common at the higher elevations.

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PLANTS.

From Royal Gardens, Kew.

- Musa Basjoo, Sieb. & Zucc.
 Musa Martaban
 Gundy Banana

From Messrs. F. Sander & Co., St. Albans, England.

- Dendrobium undulatum
 D. bigibbum giganteum
 D. Phalaenopsis Schroederianum
 Cattleya Leopoldii
 Cattleya spp.
 Epidendrum Godseffianum
 Peristeria aspera
 Cyrtopodium sp.
 Saccolabium præmorsum.

From T. B. Beach, Florida.

- Thirty Orange Plants.

SEEDS.

From Messrs. Reasoner Bros., Oneco, Florida.

- Ampelopsis quinquefolia
 Anona glabra
 Carya tomentosa
 Diospyros Kaki
 Hamelia patens
 Nerium atropurpureum
 Panicum excurrens
 Catalpa (Japanese Hybrid)

From Messrs. Damman & Co., Naples, Italy.

- Iris germanica
 Iris florentina

From Botanic Gardens, Bangalore.

- Hibiscus panduræformis.

From Botanic Gardens, Seepore, nr. Calcutta.

- Phoenix paludosa.

From Royal Gardens, Kew.

Ilex paraguayensis
Protea abyssinica
Prinsepia utilis
Doryanthes Guilfoylei.

From Acclimatisation Society of Queensland

Rubus flavus (Indian Raspberry)

From Botanic Gardens of McGill University, Montreal.

Sicyos angulatus
Celastrus scandens
Celastrus articulatus
Aralia racemosa.

From Botanical Station, British Honduras.

"Warree" Cohune Palm
Euterpe edulis
Sabal excelsa
Bactris horrida
 Palm-unnamed.

From Mr. R. Elworthy, Priestman's River.

Logwood.

From Mr. E. Builer, Kingston.

13 varieties of Water-melon.

From Mr. Wm. Soutter, Brisbane.

Rubus flavus.

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.]

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Parts 3 & 4.

RAMIE, RHEA, CHINA GRASS.

BOEHMERIA NIVEA, Hook. & Arn.

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Description.—This plant belongs to the Nettle Family (*Urticaceae*). It grows to a height of from 4 to 8 feet. The leaves are alternate, toothed, 3-nerved, broadly ovate, rough above, snow-white on the under surface in one variety, greenish in another. The flowers are very small in clusters along a branched stalk, and both male and female flowers occur on the same plant.

Varieties.—RAMIE is the Malay name for the variety native in the Malay Archipelago, which is greenish on both sides of the leaf. It has been cultivated in Assam for long periods, and is there known as RHEA. This variety is distinguished by the name *tenacissima*. The variety with the whitish under-side of the leaves (*nivea*) is a native of China and has been conveniently designated the CHINESE WHITE.

NETTLE. The fibre prepared from it, and imported into England, is known under the inappropriate name of CHINA GRASS.

China grass fibre generally obtains double the price in London of Rhea. Some writers state that the variety *tenacissima* produces the strongest fibre.

Introduction into Jamaica.—The white-leaved variety was introduced into Jamaica in the year 1854 by Mr. Nathaniel Wilson, Island Botanist, and grown with great success in the Botanic Garden at Bath. Plants were distributed from that centre as early as the year 1855. In 1884, Mr. D. Morris, at that time Director of Public Gardens and Plantations, issued *Instructions on the Cultivation of Ramie*, and also discussed the subject in a Public Lecture at the Jamaica Institute on "Native and other Fibre Plants." Shortly after the delivery of this lecture, the late Hon. Dr. Phillippo delivered another Institute Lecture specially devoted to the subject of Ramie, giving results of his own experiments as well as general information on the whole subject. Dr. Phillippo had already in 1881 introduced the green-leaved variety into the Island from Haiti. At this time and for 3 or 4 years subsequently, it was confidently expected that the Favier-Frémy process had solved the difficulty of preparation of the fibre. At the present time when hopes have been raised that Ramie may still become one of the industrial products of the island, it has been thought advisable to issue these notes for the information and consideration of the public.

CULTIVATION.

Climate.—The Malayan Ramie is essentially a native of an equatorial insular climate, with an equable temperature all the year round, and abundance of moisture. It has not succeeded well in India, except in the south where a Company is growing it, because in summer it is subjected to long-continued droughts and in winter to cold weather. In Jamaica there are no great extremes of temperature, and therefore wherever there is a sufficiency of fresh water for the roots, Ramie will flourish. Even in localities where the annual rainfall does not exceed 50 inches, it would probably succeed with irrigation.

The Chinese White Nettle is a continental plant, and apparently more accomodating as regards moisture and drought than the Malayan variety. It has grown luxuriantly in Jamaica from sea level up to perhaps 3,000 feet, and there is no reason to suppose that there would be any difficulty in cultivating it at the highest elevations. In Europe it succeeds best in the more northern areas, and the Malayan variety in the southern. In America, it is said that the Chinese variety is the more successful.

Soil.—This plant will grow in Jamaica in almost any soil except stiff clay. It grows best in a rich sandy loam, which is 12 to 15 inches deep, with a free subsoil. It is important to have perfect drainage, for it is intolerant of stagnant water.

Preparation of Ground.—The more thoroughly the ground is tilled before planting, the quicker will the roots penetrate the soil, and the more satisfactory will be the result.

Propagation and Planting.—Ramie is propagated with some difficulty from seed, but easily by cuttings from the stem and very readily

and quickly by division of the roots. The difficulties in the way of obtaining a yield of seed, and afterwards in growing the seedlings, as compared with the ease with which cuttings strike, make it unnecessary to discuss propagation by seed.

To propagate by stem-cuttings, let the stem become ripe, indicated by its turning brown; cut it into pieces, each containing 3 eyes or buds, close below the lowest eye, and close above the topmost; then plant so that the middle eye is just at the surface. It is not advisable to put these cuttings out at once into the open field, as they require a moist soil and shading from the sun for 10 days. It will be found better to grow them for some time in a nursery until they have well-developed roots, then plant them out at distances of $1\frac{1}{2}$ to 2 feet apart, in straight rows.

To propagate by division of roots is the best plan. It is better done in showery weather. The roots should be cut so that there are 5 or 6 eyes to each portion. Plant out in straight rows at distances of $1\frac{1}{2}$ to 2 feet apart. Some have recommended 4 feet as a proper distance, but this plan necessitates extra expense in weeding; and besides the fibre will be of better quality with close planting which prevents branching. At distances of $1\frac{1}{2}$ feet there is room for hoeing the weeds, until the plants are strong. If the ground is shaded, as some recommend, then it is not so important to plant close.

After some time every alternate row each way may be taken up altogether, and transplanted in new ground so as to extend the plantation.

A Chinese Treatise on Agriculture, says of this plant; "When the tufts are strong enough, the earth round is dug, and new stocks are detached and transplanted elsewhere. The principal stock then grows more vigorously. At the end of 4 or 5 years, the old stocks becoming excessively strong, they are divided and replanted in other beds."

Col. Hannay, in speaking of the cultivation of Rhea in Assam, says:—"Between the cuttings, all that seems necessary is a fresh opening up of the ground around the roots, which in a regular plantation is best done by hoeing between the rows with a spade-shaped hoe set in a long handle; the person, as he performs this, going backwards, so as not to step over his work; in fact, nothing can be more simple than the cultivation of this plant, all that is required being a loose rich soil, and protection to the crop by a good strong fence. The roots throw up at least twelve shoots when in full bearing; should they increase, and the crops get too thick, the roots require to be separated; and by this means the cultivation can be carried to any extent."

To put in roots at $1\frac{1}{2}$ feet apart requires nearly 20,000 roots per acre. At 2 feet apart there are 10,890 plants to the acre.

Manure.—The exhaustive nature of the plant is shown by the following analysis of dry ramie stems. The ramie stems were found to contain, in 100 parts,—

Carbon	...	...	47.28
Hydrogen	...	...	6.26
Nitrogen	...	...	0.09
Oxygen	...	...	42.23
Ash	...	...	4.14
			<hr/> 100.00 <hr/>

The ash consists of—

Potash	...	32.37	per cent.	} 48.76 per cent. of alkalis.
Soda	...	16.39	"	
Lime	...	8.40	"	
Magnesia	...	5.39	"	
Peroxide of iron	...	—	"	
Chloride of sodium	...	9.13	"	
Phosphoric acid	...	9.61	"	
Sulphuric acid	...	3.11	"	
Carbonic acid	...	8.90	"	
Silicic acid (with a little charcoal and sand)	}	6.60	"	
		99.90		

"It will be noticed that the alkalis contribute almost one-half, and the phosphoric acid about one-tenth of the ash. If the weight of dry stems obtained at one crop be taken at only 1,000 lbs. per acre, this gives, with three crops in the year, a yield of about 3,000 lbs of dry stems per acre per annum. The quantity of ash in that quantity will amount, according to the foregoing analysis, to 124 lbs., and the quantity of alkalis subtracted from one acre in the course of the year will be about 60 lbs., and of phosphoric acid about 12 lbs. In England, a crop of wheat is usually assumed to subtract from the soil about 30 lbs. of alkalis, and 28 lbs. of phosphoric acid; and a crop of flax, about 50 lbs. of alkalis, and 24 lbs. of phosphoric acid. In comparison with these numbers, it seems that ramie requires a very large amount of alkalis, especially of potash, more than either flax or wheat, whilst the quantity of phosphoric acid is only one-half of that contained in a crop of flax, owing to the large quantities of phosphoric acid contained in the linseed.

"The large quantity of mineral matters contained in the ramie stems explains the importance attached by the Chinese to the careful manuring of the plant. This is a point which ought not to be neglected; and even if it should be difficult to provide sufficient quantities of manure, the dry sticks, after the separation of the fibre, and all the refuse during its preparation, should be carefully collected, burnt, and the ashes returned to the soil. If this is systematically done, there need be no fear that ramie as a crop should prove very exhaustive to the soil, as the proportion of valuable mineral constituents taken away in the fibre itself is quite small." (*Forbes Watson*.)

- HARVESTING.

Cutting the Stems.—The stems should be cut before they turn brown, and before they flower. Dr. Forbes Watson states in a lecture before the Society of Arts:—

"One of my objects, in the experiments which I carried out in Paris, was to determine, as far as I could, the height to which the plants should be grown in order to give the largest yield of fibre. Some people say that the plant should be grown to the height of 6 feet; some say they should not be more than 3 feet; but the results of my experiments, point to the fact that $3\frac{1}{2}$ to 4 feet is about the right height to grow them. If the length is not more than 2 feet, the fibre is very fine, but the chances are you get more waste, and not such a good per-

centage of fibre. In the long stems the fibre is not so fine as in the medium ones; in short, the medium stems from 3 ft. to 4 ft. are about the right length to cut. This has an important bearing upon the question of the number of crops which can be obtained. It is clear that if you allow the plant to grow 6 or 8 feet high, you cannot expect to get as many crops as when only 4 ft. Moreover, there is this characteristic; all these stalks which you see here are from the same plant, that is to say, the shoots have come from the same root. Having determined the proper length, the stems should be gathered accordingly, only those being cut which have attained the right height; in this way a continuous crop may possibly be secured.

"We find that with China grass there is a great variety in quality. These variations in quality give rise to the complaints which are frequently made. If you grow it, however, a certain standard length, it will be likely to produce it of a definite quality, and that is what is wanted for commercial purposes."

The following paragraphs are taken from a Report on Formosa by Mr. Alex. Hosie, acting Consul at Tamsui, submitted in March, 1893:—

"The workman seizes each stem 9 inches above ground between the thumb and fingers of the right hand, snaps it over to the right causing a fracture, lays hold of the stem below the fracture with his left hand, pushes down and sideways the upper part of the stem on the fracture to complete the division of the wood, inserts the forefinger of the right hand in the fracture, which is now compound, and draws it up between the peel on the left and the wood and adhering peel on the right, removing on its way branchlets, leaves, and tip. He then draws down the peel on the left with his left hand to the root, where it is readily detached. In like manner the peel and wood on the right are removed at the root, and the wood, being but loosely attached, can be readily separated from the peel. The whole operation is simplicity itself, and can be conducted with the greatest rapidity. The result of repeated timing is that 100 stems can be peeled without haste in fifteen minutes, that is, at the rate of 400 an hour. The peeled stems and the discarded leaves, &c., remain on the field as manure. . .

"The next process is the removal of the cuticle and the bleaching of the fibre. The ribbons are made up into loosely tied bundles, which are placed in a tub of cold water. When the workman is about to remove the green cuticle from the fibre, he places on the thumb of his right hand a wide copper ring, on which a small flat piece of bamboo has been fixed, the piece of bamboo resting against the face of the thumb. In the same hand he holds an iron instrument like a shoe-horn, in such a position that he can grasp anything between the piece of bamboo and the blunt inner edge of the hand instrument. A bundle of the ribbons is then taken from the tub and unfolded. Taking ribbon by ribbon from the bundle with his left hand he grasps it about 6 inches from the wide or butt end,—the cuticle or outside of the ribbon against the piece of bamboo,—and scrapes it to the tip. After a couple of scrapings the whole of the cuticle, with the exception of the 6 inches or so at the butt, is removed, and when ten or a dozen ribbons have been treated in this manner, the workman reverses them, and removes the cuticle at the butt ends. The fibres, which remain in his left hand, are hung out over bamboos in the sun to dry and bleach for six hours, when they are white and ready to

be packed into bundles for market. One man can extract some 8lbs. weight of fibre in a day of ten hours, and an English acre of land yields about 900lbs. of fibre."

Yield.—It is estimated that each cutting gives 20,000 lbs. of green stems with leaves, or 5,000 lbs. of dry stalks, as the yield per acre, and the minimum product from the dry stalks is 15 per cent., that is 750 lbs. of raw merchantable fibre, or not quite 4 per cent. of the living stem and leaves. In good soil and plenty of moisture, five crops may be expected annually. The caution, however, must be given that until the end of the first year at any rate when the roots have at length penetrated the soil, a full crop can scarcely be expected.

PROPERTIES OF RAMIE FIBRE.

In order to give some idea of the possibilities of this fibre in the future, the following paragraphs on its properties and the uses to which it may be put, are taken from a Report to the Secretary of State for India in the year 1875 by Dr. J. Forbes Watson.

There can be no doubt that ramie fibre is considerably stronger than either flax or hemp.

Ramie has also a high resisting power of another order. The resisting power of fibres under the influence of moisture and various atmospheric conditions, may be to some extent tested by the action of high-pressure steam on them. The percentage loss of a specimen of Chinese rhea amounted only to 0.89, and of Assam rhea to 1.51, whilst flax lost 3.50 per cent., Italian hemp 6.18, Russian hemp 8.44, and jute even 21.39 per cent.

Although strong and resisting, the fibres of the ramie are as fine, if not finer, than those of flax, the mean diameter of the ultimate fibres of flax is about $\frac{1}{2060}$ of an inch, of ramie (from Assam) about $\frac{1}{2160}$, and of China grass $\frac{1}{2260}$ of an inch. Occasionally, however, samples of prepared ramie are met with in a state of even greater division, either from a more complete disintegration, or perhaps even from the greater original tenuity of the ultimate fibre.

Whilst, therefore, as regards strength, resistance, and fineness, ramie is either equal or superior to the best known fibres, it has the additional advantage of possessing in a considerable degree a silky lustre. Jute, the only other fibre which can compete with it in this respect, is far inferior to it in strength and durability, as well as in its capability for bleaching and dyeing.

USES OF RAMIE FIBRE.

Ramie in virtue of its quality, has a wide range of affinity with other fibres, though it is not perfectly similar to any of them. This explains why its experimental applications cover such a wide field. It has been actually tried as a substitute for cotton, hemp, flax, wool, and silk.

Ramie with Cotton.—With regard to cotton, attention was directed to it among other fibres during the years of the cotton famine produced by the American war. In 1862, Dickson prepared cottonised ramie, and sometime afterwards, in France, Messrs. Mallard and Bonneaud, by cutting the fibre into lengths of two inches, and treating it with alkalis and oil, produced from China grass a material suitable for admixture with cotton. This cottonised ramie was the subject of

various experiments carried out during the year 1864 by the Rouen Chamber of Commerce. In the present state of the cotton trade it is not very likely that ramie will ever be used for such a purpose, as, apart from considerations of price, cottonised ramie hardly permits advantage to be taken of the peculiar and prominent qualities of the fibre,—its length, strength, smoothness, and lustre. Nevertheless, the Rouen experiments are interesting, as throwing some light on its manufacturing qualities. Under Messrs. Bertel and Cordier, of Rouen, the cottonised ramie was spun, and the yarn woven into different fabrics, and dyed and printed; in the first experiment it was mixed with an equal weight of Egyptian cotton, and in the second and larger one (on 220 lbs of cottonised ramie) with an equal proportion of Indian cotton. The fabrics, as compared with those of pure cotton, are reported to have gained in strength, and to have acquired a certain amount of gloss, rendering them more similar to linen fabrics. Neither the spinning nor the dyeing gave rise to any difficulties. The mixed fabrics are reported to have dyed as well as those of Egyptian or American cotton, and better than fabrics of Indian cotton. Only with a few colours was it necessary to modify the mordant or the strength of the dyeing bath, in order to obtain the same shade of colour as with unmixed cotton.

Ramie with Wool.—The application of ramie which has hitherto attracted most attention, and which for a time achieved the greatest share of success, is its use as a substitute for long-stapled wools. Both the nature of the fibre and the higher prices of the materials for which it acted as a substitute, have hitherto favoured experiments in this direction. The hairy nature of the fibre has been noticed. The cells of which the fibre consists are from three to eighteen inches long. Under chemical treatment, these cells are separated from each other, and the long fibre falls naturally into lengths of from four to nine inches, and in that state bears a striking similarity, when not too closely viewed, to some long-stapled hairs and wools. Combing produces long fibre and tow, or noils, in about equal proportions. The average yield from rough China grass may be taken as one-third combed fibre, one-third noils, and one-third loss by chemical treatment, dust, &c. But good qualities of China grass yield about 40 per cent., and sometimes even 44 per cent. of combed fibre.

The prepared ramie, or China grass, cut up into suitable lengths, has, in fact, been found capable of being spun on worsted machinery, and then used, like mohair or other long-stapled wools, for the manufacture of certain kinds of fabrics which depend for their effect on the gloss of the material. These fabrics were, made, as a rule, with cotton warps, ramie yarn of comparatively little twist being used as weft. The use was mainly for ladies' dresses and at first it seemed as if the success was complete. But after a certain time the inferiority of the new fabrics for ladies' dresses became manifest. Although everything that could be desired as regarded appearance and finish, there was the fatal objection that in wear they became easily creased, as the vegetable ramie fibre is wanting in the great elasticity possessed by wool. In view of such an inferiority, the prices then ruling for ramie made its use for this purpose no longer remunerative. The new trade collapsed as rapidly as it had sprung up, and since 1872 the matter is again

one of experiment. The creasing, however, is to be got over by mixture with wool, or by the use of very thick cotton warps, and fabrics of a new kind have been manufactured on a small scale, and have found a ready sale.

There is also sufficient evidence that at prices of raw material permanently lowered, there would be a larger field for the use of ramie as a substitute for long-stapled wool. Even if its use for ladies' dresses were not again resumed, there are hangings, carriage linings, carpets, and other manufactures for which the suitability of ramie has been established, and for which its application continues to engage the attention of some of our most eminent manufacturers. There are several circumstances favouring the use of ramie in this line rather than in competition with flax. The material competed with is higher priced than flax, the better class of wool varying from £130 to £280 per ton, whilst those which in their raw state are lower priced contain such a proportion of dirt that the price for the really available fibre is, here also, in reality, not much lower. Thus the technical difficulties in the way of spinning and weaving ramie on worsted machinery have been much better overcome than similar difficulties encountered in using it as a substitute for flax. There is also the circumstance that the ramie combing waste, or noils, has been found very suitable for mixture in bulk with rough kind of wool, and capable of being used for blankets, as also, possibly, for giving strength to shoddy, and for a variety of other rough purposes.

Ramie with Silk.—A great number of experiments have been tried with regard to its suitability for being used as a substitute for silk, or even as an admixture with it. The glossiness of the finely-prepared ramie naturally suggested this use. Both in England and in Lyons the subject has been taken up repeatedly; and though, by the application of ramie, it is possible to imitate to a certain extent the effects of silk in certain mixed fabrics, the special use of ramie for this object has never acquired any real footing, apart from the fabrics relying on very similar effects which have been prepared from it on worsted machinery, and already noticed. As regards mixture with silk also, ramie has a formidable rival in the much cheaper jute, now largely used for this purpose.

Ramie compared with Flax and Hemp.—In the cases in which ramie is used as a substitute for flax, wool, and silk, it is made to compete with high-class fabrics, for which it must be rendered fit by means of a complicated manipulation, and it is put essentially to a new use different from those to which it is applied in the countries of the original growth, such as China and the East Indies, because the fine grass-cloth fabrics produced in China, and woven not from ramie yarn but from untwisted bundles of fibres joined end to end, either by the gum naturally contained in the fibre or by a special kind of knot, cannot be compared with any fabrics produced in this country. On the other hand, the use of ramie for purposes for which hemp is used in this country is generally practised in Assam, in parts of Bengal, and in the East Indian Archipelago. It is used for nets, fishing lines, and other purposes for which strength, lightness, and power of resisting water are essential.

Another point of great importance is the superiority of ramie to hemp as regards strength and resistance to water. The greater strength of ramie may make it possible to replace hempen cordage by lighter ramie ones. For many purposes, such as ships' rigging, the increase in lightness is in itself an important consideration, apart from the saving of the material. It is this circumstance which has rendered Manilla hemp so valuable as compared with the ordinary hemp. On all these grounds ramie may be substituted with advantage for hemp, even if it be at a considerably higher price than hemp. The same may be said of its cognate use for canvas and sailcloth instead of flax. In that case also the superior strength of ramie results in the double advantage of a saving in material and of greater lightness, and would enable it to compete successfully with flax, even if this latter were considerably cheaper per ton.

Ramie as Paper Material.—The use of ramie fibre as a paper material is, of course, not likely to be of any primary importance. Some of the waste, however, may come in for this purpose. Communications from experienced paper manufacturers have been received with respect to the use of ramie as a paper material, all speaking in a hopeful tone, and considering that a certain admixture is sufficient to impart strength and cohesion to very inferior materials.

CONCLUSIONS WITH REGARD TO THE FUTURE PROSPECTS OF RAMIE.

By Dr. Forbes Watson.—The foregoing short account of the physical properties of the ramie fibre, and of the various uses to which it has hitherto been put, gives an idea of the wide range of its applications, and leads to several clearly defined conclusions.

It appears that there hardly exists a fibre which, in virtue of its own inherent properties, can be applied to so many different uses. Amongst the fibres which already enter largely into textile manufactures, flax is, perhaps, the one which possesses the most extended range of applications—from the roughest canvas and cordage, to the finest lace; yet the range of ramie is even greater still. This is due, partly, to the superlative degree in which it possesses certain qualities, such as fineness, strength, and lustre, not usually associated in the same perfection in any single fibre, and partly to the curious intermediate position which it holds between the usual vegetable and the animal fibres. Although a vegetable fibre, its hairiness assimilates it to wool, and its gloss and fineness to silk. The resemblance to wool, ramie shows in common with the other nettles, the Neilgherry nettle, for instance, which is however, so very rough and hairy, that it could never compete with smooth fibres, such as flax, whereas ramie can be rendered fit for either use. Thus ramie combines the whole range of applications of hemp, to which it is superior in almost every respect, with almost the whole range of the uses of flax, excepting, perhaps, its use for body linen, together with certain other uses for which only the animal fibres, wool and silk, have hitherto been employed.

If, therefore, the extensive introduction of ramie into manufactures depended upon its own inherent qualities, there would be hardly a fibre which had ever better chances of success. The obstacles in the way of such a successful result are the technical difficulties experienced in spinning and weaving, and the high price of the raw material. It may, however, be stated that the price is the only serious obstacle, since

most of the technical difficulties have either already been overcome, or are sure to be so if once a lower price should render its use sufficiently remunerative.

It is the high price of the raw material which explains the fact that ramie, although brought to notice in this country only about fifteen years later than jute (introduced in England, in the last decade of the present century), is still, notwithstanding its superior qualities, in very much the same position as it was in 1816, when the Court of Directors considered it as proved that it could be used for the finest Brussels lace, and when they sent out to India machinery for the preparation of the fibre; whilst jute, in the meantime, has become one of the leading Indian staples, the value of the exports of jute and jute manufactures from Calcutta in the year 1872-73, amounting to more than £5,000,000.

But from the very beginning, jute took its stand at the bottom of the price list as the cheapest of fibres, its price about the year 1830, before it had yet received any extended application, being between £10 and £12 per ton, and for many years subsequently it never, except for short periods, rose beyond £15 or £16 per ton. This low range of prices supplied the stimulus which led the manufacturers to incessant experiments with it until about 1850, when, after an experimental period of almost twenty years, all the mechanical difficulties of its working had been surmounted, its special uses ascertained, and the new manufacture established on a firm basis. It must be remembered also, that even with the stimulus of low prices, forty-three years passed between 1796, when it was first imported into England, and 1839, when it was first utilised on a large scale, that is to say, not merely as an occasional adulterant of other fibres, but for the manufacture of fabrics *sui generis*. It was only in that year that Mr. Rowan, of Dundee, succeeded in persuading the Dutch Government to employ bagging made from jute as a substitute for that made from flax tow, for the use of the Dutch coffee plantations in the East Indies.

The stimulus which, in the case of jute, was afforded by low prices, will, in the case of ramie, be sufficiently supplied by its own high-qualities, if only the prices do not become prohibitive. Ramie possesses qualities which will always make it a comparatively high-priced fibre, standing as it does between the vegetable fibres, hemp and flax, ranging from £30 to £70 per ton, and the usually much higher priced animal fibres, wool and silk, ranging from £130 per ton upwards. It is only in competition with these latter that ramie will have to rely on its cheapness; since, as regards the other vegetable fibres, it has already been noticed that, at equal or even superior prices, it may yet in many cases be used with advantage instead of hemp and flax. The details supplied prove, however, that the prices of the raw material have in reality been hitherto prohibitive. On any greater demand for it, the prices of the raw fibre rose at once to £70 or £80 per ton, which corresponds to £100 or £120 per ton of available fibre, exclusive of costs of preparation. Prepared or combed fibre was usually sold at 2s. 6d., sometimes 3s. 6d. per lb., or £280 to £392 per ton, prices such as, with the exception of the best kind of Sea Island cotton and of some superfine kinds of flax, which may almost be called fancy varieties, no vegetable fibre commands. The combing wastes or noils

of ramie even now, find a ready sale at from £80 to £100 per ton, a price which, with the present prices of rough China grass, might make it remunerative to convert its whole quantity into combing waste, if so be that this could be practically carried out. Under such conditions, it is a striking acknowledgment of its value that it should ever have been considered as having any chance at all, and have come so near to actual success as it has done.

In considering what range of prices would be sufficient to secure a large demand for this material in the present state of the market, several circumstances must be taken into account.

It is important to bear in mind that, like all other fibres, ramie exhibits remarkable differences of quality. In China, where alone it is used for any fine purposes, a difference is even remarked between the various layers of fibre on the same stem, the outside layer close to the bark being stronger and rougher, whilst the inner layer is glossier and finer, and more suitable for high-class fabrics. It is also highly probable that, as in flax, the fibre at the base of the stem is rougher than at the top. Well-marked differences arise from the season of cultivation and the time of cutting. The first crop of the plant is usually shorter and more woody and branched, and yields inferior fibre to the second or third crop, which, in turn, appear to differ from each other. It seems also certain that, like jute, the early-cut stems yield a finer fibre, but in proportionably small quantities, whilst in the perfectly ripe stems the fibre increases in weight and strength, but diminishes in fineness and lustre. If the ramie stems be worked up in their fresh state, and if the time of cutting should have extended over four or six weeks, this in itself would be sufficient to produce fibre of different qualities, even from the same plantation.

A difference in the soil or mode of cultivation is as sure to produce remarkable differences in the qualities of the fibre as it does in the case of flax or jute. In the ramie stems obtained from France, there was a proportion of strong branched knotty sticks, more than half an inch in diameter at the bottom, whilst there was also a considerable proportion of thin shoots, hardly a quarter of an inch thick, and straight and smooth, although as high as the former, and containing a much finer fibre. The difference arose obviously from the former growing as central stems with a number of lateral branches, while the latter grew as parallel shoots thrown out from the same root—a difference which the mode of planting and cultivation would produce.

On the part of several correspondents who have long given their attention to this fibre, it has been suggested that, for very fine purposes, this plant should not be grown to a greater height than three or four feet, the superior value of the fibre compensating for the diminished out-turn per acre, although even the out-turn might be increased or at least remain unchanged, if the smaller height to which the plant is grown should allow of planting it closer together, or of obtaining more crops per annum than when the plant is grown to its usual height of six or eight feet. The fibre from the smaller stems is likely not only to be finer, but it is also likely to suffer less loss in combing. Although the bark peeled off the six to seven foot stems may be of the same length as the stems, yet the fibres do not run the whole length. At each joint a certain proportion of the fibres stops, so that along with

the full length fibre there is always a certain proportion of short lengths, which, in scutching and combing, mostly run to tow. With stems of less height, this difficulty is likely to be lessened.

All these are differences in the natural properties of the fibre itself, and independent of variations produced by a different mode of preparation. The latter, which will be superadded to those inherent in the fibre as grown, will be hardly less considerable. There is the difference between the fibre obtained from the green stems and that from the dry stems. The subsequent chemical treatment may result in a greater or less disaggregation of the original fibre, and materially influence its character. On all these grounds it appears that the ramie brought into the market will, under any circumstances, even with the most perfect methods of cultivation and preparation, manifest considerable differences in its quality and property—differences greater than is the case with other fibres. As before explained, it is quite likely that, even from the same plantation, some of the produce may be remarkable for strength, but deficient in fineness and gloss; another portion, fine and glossy, but less strong; another, by its roughness and hairiness, approaching wool in its character.

Ultimately, this very range in the quality may prove an advantage; but first, in the experimental stage, it is a decided disadvantage; and it can be easily shown that this is, in itself, a sufficient reason why it is impossible to expect that ramie should, from the first, command such high prices as its good qualities are likely to ensure to it, after its cultivation and preparation have become more developed. A high price of necessity restricts the application of the fibre to the very finest purposes. Now, it is the invariable characteristic of high-class manufacture to require perfect uniformity in the quality of the material used in it. Not only must each bale of fibre used for fine purposes be as nearly as possible uniform in its quality, but it is likewise necessary to ensure the steady supply of other bales as uniform, and of the very same quality. It is an established fact, that in the case of any inequality in the material, the whole quantity will sink almost to the value of the lowest quality contained in the mixture, and that no high-class expensive machinery will ever be established, unless there are grounds for expecting that the quality of the raw material will be uniformly maintained. In any other case, the fibre can only be used for rougher purposes, and worked on simpler machinery, in which such variations in quality are of no moment.

As before explained, there will be in the case of ramie even greater difficulties than in the case of other fibres, in ensuring this perfect equality in condition, as a considerable amount of variation in the character of the fibre is unavoidably connected with the very nature of the growth of the plant. It will require a perfect knowledge of the nature of the plant, and of the fibre and its working, and a perfect mutual understanding between the agriculturist growing it, the machinist cleaning it, and the manufacturer spinning it. This can only be the slow result of time, and will only have been attained when cultivation being more extended, the trade conducted on a larger scale, it will be possible to carry out a complete sub-division of the crop according to its various qualities, and when the best practical uses of each quality will have been ascertained. Moreover, in any case, even with the agri-

cultural and mechanical treatment, it is likely that only a certain part of the crop will be suitable for fine uses, whilst a considerable proportion will only be available for rougher purposes. So that, unless the method of preparation allows of utilising this rougher portion of the crop also, the remaining portion suitable for fine purposes will always be disproportionately dear.

It is clear, therefore, that a rapid development of the ramie trade cannot be expected, until the bulk of the raw fibre can be supplied at a price much below that which it will eventually attain when its higher qualities have been more fully developed, and below that which the finer portion of the crop is likely to command even now. It may finally come to be applied to the manufacture of damask, cambric, and lace, but for some years to come, even if its use for such purposes should prove successful, it will have to be worked up by manufacturers only gradually discovering its properties, and on machinery with processes imitated from those used with other fibres, and therefore not specially adapted to ramie. The consumption of the fibre for fine purposes during that experimental stage will be necessarily small, and restricted only to the best qualities. No real outlet, therefore, will have been obtained for ramie unless it be applied for purposes for which, in the opinion of some of its sanguine advocates, it is far too good, such as for cordage, as also for canvas, mixture with rough wools, lower kinds of carpets, hangings, linings, certain kinds of linen, &c. It is also to be remembered that only by becoming suitable for the manufacture of comparatively cheap articles produced in large quantity, is there any hope of its becoming a great staple. If it were able to compete with only the Courtrai flax, and no cheaper fibres, however successful it might be in this respect, it would never develope into a large trade.

It will appear clearly from this discussion, that in all probability the standard price of £50 per ton for machine-prepared ramie in the London market, which was considered sufficiently low in 1870 to ensure its extensive introduction, is in the present condition of the market too high to effect this object. Such a price of raw material for fibre available for spinning would correspond, as already calculated, to a price per ton of £75, with the addition of the cost of chemicals, a price which would amount to rather more than that of the finest variety of flax, which enter extensively into the commerce of the country. If ramie, with all the disadvantages attending the introduction of a new staple, is to compete successfully with the fibres which already have possession of the market, there must be some likelihood of obtaining steady supplies of the rough fibre at prices which correspond more nearly with the prices of the other vegetable fibres, such as flax and hemp, that is, at an average price of (at the outside) from £30 to £40 per ton for the better, and from £20 to £25 per ton for the lower, qualities. Even with such prices, the fibre freed from gum, and in a condition similar to that of undressed flax, could not be prepared at less than from £35 to £60 per ton, plus cost of chemicals. Considering its superior qualities, however, such a price would seem sufficiently low to bring ramie into competition with flax and hemp, even if the latter were somewhat cheaper. It has also to be considered that the limits of prices for ramie will, of course, always depend on the state of the market with regard to fibres generally, and that, at present, the values

of all the fibres are much lower than they were some years ago. With a recovery in the value of other fibres, the limits of prices here indicated for ramie would have to be proportionately increased.

Kew Bulletin on Ramie. These conclusions of Dr. F. Watson in 1875 may be supplemented by the following articles by Mr. D. Morris in the *Kew Bulletin* :—

The difficulties attending the development of the Ramie industry appear to be not confined alone to preparing the fibre. It is also found that those who have in a measure been successful in preparing the fibre in commercial quantities are disappointed with the reception this fibre has received at the hands of spinners and manufacturers. In a word, it is found that Ramie fibre when produced is practically unsaleable in the London market at the present time. A correspondent interested in Ramie estates wrote to Kew a short time ago :—

“We have spent much capital on Ramie, but as yet cannot see our way to commercial success. We have produced excellent filasse, but the cost has been far too great and the chief difficulty seems to rest, not in the production of filasse, many systems [if the question of cost is set aside] have accomplished this, but in the spinning of the filasse into yarn. No British manufacturing firm appears willing to take up this business except on terms that would practically give them the monopoly; they also require a guaranteed minimum of raw material which we cannot give.”

In a subsequent letter the same correspondent states :—

“I am beginning to think that the only way to succeed with Ramie is to follow M. Favier's system namely, to grow and treat it for a special purpose, and carry it right on to manufacture. Then it will pay right well. At present the filasse that would suit one manufacturer would be useless to nine others, who would want it prepared differently.”

Another correspondent, from a different point of view, appears to confirm the experience detailed above :

“In the *Kew Bulletin* for June last there is an article upon Ramie or Rhea fibre. Have you had any applications from, or can you put me in communication with, any manufacturers, who may be disposed to take up this fibre as a specialty? I am interested in a works and process for the preparation of Ramie filasse in the form similar to the enclosed sample. With our present appliances we could undertake to deliver it at from ten to twenty cwts. weekly. So far we have not been able to find any manufacturers here so inclined, and the prepared material has been sent abroad. If you can render me any assistance it will be esteemed a favour.”

Since the receipt of these letters, Kew has been favoured by Messrs. Ide and Christie, a firm of fibre brokers in London, with a copy of their monthly circular, dated the 15th November. In this circular, under the head of China Grass and Ramie, it is stated ;—

“On the 31st ulto. a large parcel, consisting of about 130 tons ribbons and 20 tons ramie or rhea in various stages of preparation, were put up for public sale, practically without reserve, and after being widely announced. The prices realised, viz., £8 to £9 per ton for the ribbons, and £20 to £25 for the ramie, were most disappointing and testified to the languid interest which this material possesses for the manufacturers of Europe. Considering the attention with which

planters in various parts of the world regard this material, and the numberless processes and machines which inventors have set forth for its manipulation, the result of this sale must be viewed as distinctly discouraging. It would almost appear as if no true demand exists for this interesting fibre, and that, in the present attitude of the manufacturing interest, the application of skill either to cultivation of the plant or extraction of the 'filasse,' is premature and misplaced."

In order to understand the present position of the Ramie industry it would be useful to adopt some kind of classification of the details connected with it. In the first place we have the mere business of cultivating the Ramie plant, and of producing stems with the fibre in the best possible condition. This is purely the work of the planter. Secondly, we have the process or processes necessary to separate the fibre from the stems in the form of ribbons and filasse. It is necessary for many reasons that this should be done either by the planter on the spot, or by a central factory close at hand. Thirdly, we have the purely technical and manufacturing process in which Ramie filasse is taken up by the spinners and utilized in the same manner as cotton, flax, and silk are utilized for the purpose of being made into fabrics.

For our present purpose we may take it for granted that the cultivation of the Ramie plant presents no insuperable difficulty. Also that if a suitable selection of soil is made, and the locality possesses the necessary climatic conditions as regards heat and moisture, there is no reason to doubt that Ramie could be grown to greater or less extent in most of our tropical possessions. As regards the second stage—in which is involved the decortication of the Ramie stems—the problem is by no means completely solved.

On this really hangs the whole subject. The third stage is disappointing and unsatisfactory, because the second stage is still uncertain; and being thus uncertain the fibre is necessarily produced in small and irregular quantities, and only comes into the market by fits and starts. It would appear that Ramie fibre differs so essentially from cotton and flax that it can only be manipulated and worked into fabrics by means of machinery specially constructed to deal with it. Owing to the comparatively limited supply of Ramie fibre hitherto in the market no large firms of manufacturers have thought it worth while to alter the present, or put up new machinery to work up Ramie fibre. If appliances, or processes for decorticating Ramie in the colonies were already devised, and the fibre came into the market regularly, and in large quantities—say hundreds of tons at a time—there is no doubt manufacturers would be fully prepared to deal with it. At present the industry is practically blocked by the absence of any really successful means of separating the fibre from the stems, and preparing it cheaply and effectively. This, after all, is the identical problem which has baffled solution for the last fifty years. (*Kew Bulletin*, December, 1888).

The result of the Paris trials last year [1888] naturally discouraged Ramie growers, and little if any extension of Ramie planting has taken place since that time. The result of the recent trials will no doubt be closely scanned by those interested in the subject. The first aim of planters should be to produce ribbons of good quality at the lowest possible cost. In other words, planters have to solve the question how

to produce Ramie ribbons, that is, to secure the complete removal of the cortex (which contains the fibre) from the green stems, at such a cost as will prove remunerative to themselves and at the same time allow sufficient margin for the cost of converting these ribbons into filasse ready for the spinners. Hitherto the want of success in the production of ribbons has apparently been the only obstacle to the development of a Ramie industry. And probably on this account the Paris trials were wholly devoted to the production of ribbons and not of filasse. The conversion of ribbons into filasse is a subject believed to be more easily dealt with. In fact there are several systems exclusively devoted to this department which appear to accomplish it. Some machines, it is true, have attempted to produce filasse by a single process from the green stems. The result has not been satisfactory, and it is very unlikely that this can be done with a plant like Ramie, in which the individual fibres are so completely immersed in gummy matter. Hence the subject has been divided into two parts. The first is concerned alone in the removal of the fibre in the form of ribbons from the green stems, either in the fields or in their immediate neighbourhood. The second is devoted to the treatment of these ribbons and in their conversion by chemical and other processes into filasse, or fine white silky fibres ready for the spinner. The first process will naturally take place where the plants are grown, in the Colonies or elsewhere, and machines like those of Favier and De Landtsheer, or processes like that of Fleury-Moriceau, may be adopted according to the special circumstances of the planter. Sufficient progress has now been made in the working of these machines and processes to justify careful trials being undertaken with them both in India and the Colonies. If these machines or any others that may be forthcoming prove entirely satisfactory, and ribbons can be produced at a low initial cost, the question of their conversion into filasse is one which will naturally come into prominence. The conversion of ribbons into filasse will very probably at first at least, take place in Europe, where chemicals and skilled labour are the more readily available. In some countries it may be found advisable later on to establish central factories or *usines* on the spot (to save freight charges on the ribbons), and ship only the filasse to Europe. In any case once a Ramie industry is well started, there can be no doubt numerous countries will seek a share in it, and only those possessing special advantages for the growth of the plant, a supply of cheap labour, and good facilities for transport and shipment can hope to make it a success.

The best market for Ramie at present appears to be France. What little is imported into England, in the form of China grass or Rhea is bought up for the French market. In the Monthly Circular of Messrs. Ide and Christie for the 15th October, 1889, China grass is quoted "quiet" at 31s. to 35s. per cwt.; and Rhea, "no business," at 14s. to 10s. per cwt.

With regard to what is known in commerce as "China grass," this is hand-cleaned fibre shipped usually from Chinese ports. It arrives in this country in small parcels, the yearly importation being only about 100 tons. It is nearly all taken up by continental buyers. Rhea is the term applied to machine-cleaned fibre, generally in the form of ribbons or half cleaned stuff. The price is much less than China grass, and in

case of large shipments would probably not exceed about £7 or £8 per ton. It is important therefore for Ramie planters to aim at the production of ribbons at a cost not exceeding about £4 or £5 at the port of shipment. Important elements in such production would be to plant Ramie only in places where the soil and climate will allow of three or four crops to be reaped per annum; where labour is very cheap and abundant, and where good facilities exist for transport and shipment. (*Kew Bulletin*, November, 1889.)

In Ide & Christie's *Monthly Circular*, dated 15th March, 1894, China Grass is quoted "quiet" at 28s. to 30s. per cwt.; and Rhea "15s. quotation."

MACHINERY FOR SEPARATION OF THE FIBRE.

Dr. George Watt, Reporter on Economic Products with the Government of India, gives the following summary of the history of the invention of machines:—

The ramie or rhea fibre having been made known in Europe at the beginning of the present century, the attention of experts seems immediately to have been turned to the question of improvements in the extraction and preparation of the fibre. The first patent was taken out by a Mr. James Lee—'for separating the fibre by mechanical means without the aid of water retting.' No tangible results, however, seem to have been obtained so far as can be ascertained from the employment of this machinery. Meanwhile attention continued to be devoted to the question, and among other inventions may be cited the chemical process of Messrs. L. W. Wright & Co., for which these gentlemen obtained a patent in 1849. Their process 'consists essentially in a very ingenious arrangement for boiling the stems in an alkaline solution after they have previously been steeped for 24 hours in water of a temperature of 90°. The fibre is then thoroughly washed with pure water and finally subjected to the action of a current of high-pressure steam till nearly dry.' At the London International Exhibition of 1851 these gentlemen exhibited samples of rhea prepared by their process, and received a silver medal. Two other exhibitors were also awarded prizes, but still the question of the preparation of the fibre remained unsolved.

In 1869 the Government of India turned its attention to the utilisation of the rhea fibre, and issued a Resolution in which it expressed the conviction that the value of the rhea fibre was undoubted, that all the conditions necessary for its cultivation on a large scale were present in India, and that the only obstacle to the development of an extensive trade in this product was want of suitable machinery for the separation of the fibre from the stem and bark of the plant in its green and freshly cut state. To encourage the invention of such machinery an announcement was made by the Government of India in June, 1870, that a public competition would be held and a prize of £5,000 would be given for the best machinery. No fewer than 32 competitors entered their names, but at the last moment only one of them, Mr. Greig, of Edinburgh, appeared in India. The trial took place in August, 1872, at Saharunpur, where a plantation of rhea had been established for the purpose. It was found that the cost of preparing the clean fibre by this machinery amounted to more than £15 a ton, and at the same time the fibre was pronounced defective in quality and was valued at £28 a ton only in

England, and declared suitable for cordage only. Under these circumstances the full amount of the prize was not awarded, but in consideration of the fact that the machine was a bona fide and meritorious attempt to meet the requirements of the case, a donation of £1,500 was given to the inventor.

Meanwhile the demand for rhea fibre in Europe seemed to continue. Having reconsidered the matter the Government of India, in a Resolution dated August, 1877, renewed the offer of rewards. The terms now offered were that a reward of 50,000 rupees would be given to the inventor of the best machine or process which would separate the bark and fibre from the stem, and the fibre from the bark of the *Bœhmeria nivea*, and a further reward of 10,000 rupees to the inventor of the next best machine or process, provided it was adjudged to possess merit, and to be capable of adaptation to practical uses. The machine or process required was to be "capable of producing by animal, water or steam power, a ton of dressed fibre of a quality which shall average in value not less than £45 per ton in the English market, at a total cost, including all processes of preparation and needful allowance for wear and tear, and not more than £15 per ton laid down at any shipment port in India, and £30 in England after payment of all charges usual in trade before goods reach the hands of the manufacturer." The machinery was to be simple, strong, durable and inexpensive, and suited for erection in plantations where rhea was grown.

The trials were fixed to commence on the 15th September, 1879, and a Committee of Judges was appointed to conduct them. Twenty-four applications for permission to compete were received, but only ten competitors ultimately arrived at Saharanpur, and of these, three withdrew from the competition. The trials were held in September and October, 1879.

The fibre turned out by each of the competing machines was carefully packed and despatched to the Secretary of State, with a view to its being tested and reported on by experts in the trade in England. The reports received from the Secretary of State (August, 1880) stated that the samples were far inferior to the fibre imported into England from China, the value of which, at that period, was £50 a ton. As no competitor had produced a fibre of a value even approaching the amount fixed in the Resolution of August, 1877, the Committee did not recommend the grant of either of the prizes to any of the competitors. They were, however, of opinion, that some of the machines possessed sufficient merit to warrant the grant of a reward to the owners, and the gentlemen mentioned by them as deserving of remuneration were Messrs. Nagoua, Vander Ploeg and Cameron. The fibre turned out by Mr. Vander Ploeg was valued less highly than that produced by Messrs. Nagoua and Cameron, but the Committee attributed this to the fact that he aimed at producing the fibre in a finished state, fit for the spinner, (a condition in which it was understood that the English dealer did not require it), and not to the inability of his machine to yield as good fibre as those of Messrs. Nagoua and Cameron. The Committee remarked also that there was little novelty in Mr. Cameron's process, and that it was only an improvement on a method by which fibre was actually extracted from various plants by the natives of India. The same method was also applied in many of the Indian Jails for the extraction of aloe fibre. The process was simple enough, and might be employed by the natives without spe-

cial instruction, and any kind of stem, green or dry, short or long, could be treated by it. but it would be difficult of application in a rhea plantation, where the stems of many acres of land would have to be worked off quickly. Having regard to these circumstances, the Committee recommended that a grant of 5,000 rupees, each be made to Messrs. Nagoua and Vander Ploeg, and another of 1,000 rupees, to Mr. Cameron.

The Government of India reviewed the above facts in a Resolution, dated March, 1881, and decided, in concurrence with the Committee, that as none of the fibres produced came up to the conditions prescribed, the prizes offered in 1877 could not be awarded. At the same time the Government of India agreed in the Committee's opinion that some recognition of their efforts was due to the three gentlemen whose machines yielded the best results or appeared to possess superior merit, and sanctioned the grants to them of the sums recommended by the Committee. The Government of India further stated that 'from the low valuation put by the English firms on the samples of fibre produced at the late competition, it does not seem probable that India rhea fibre will be able, for the present at least, to compete successfully with the Chinese production, while the experience which has so far been gained also points to the conclusion that in most parts of India the cultivation of rhea cannot be undertaken with profit. Rhea is naturally an equatorial plant, and it requires a moist air, a rich soil and plenty of water, while extremes of temperature are unfavourable to it. Such conditions may be found in parts of Burma, in Upper Assam and in some districts of Eastern and Northern Bengal, and if rhea can be grown in such places with only so much care as is required in an ordinary well-farmed field for a rather superior crop, it is possible that it may succeed commercially. Until, however, private enterprise has shown that the cultivation of the plant can be undertaken with profit to these or other parts of the country, and that real need has arisen for an improved method of preparing the fibre in order to stimulate its production, the Government of India thinks it inadvisable to renew the offer which it has now made for the second time without result, of rewards for suitable machines. But in order to aid persons who are anxious to try the cultivation of the plant in localities which are *prima facie* suitable, the Government will be willing to place roots at their disposal. A plot of about two or three acres will, therefore, continue to be kept under rhea in the Botanical Gardens at Howrah for the supply of roots for intending growers.— (*Dictionary of Economic Products of India.*)

The withdrawal of the reward offered by the Government of India has not checked invention, and numerous processes and machines have been brought forward.

There was a public competition at Paris in 1888, and again in 1889, in connection with the *Exposition Universelle*, and Mr. D. Morris, Assistant Director at Kew Gardens, was deputed by the Indian Government to attend the trials and make reports. These reports have been published in the *Kew Bulletin* for 1888 and 1889. Mr. Morris's general conclusion was: "It is quite possible that some machine or process will eventually solve the problem, but at present the exploitation of ramie, in spite of years of labour and the expenditure of large sums of money upon it, cannot be said to have yet emerged from the experimental stage."

The Ramie Machine Trials at New Orleans in September, 1892, were held under the auspices of the Office of Fibre Investigations of the United States Department of Agriculture, but the results were not satisfactory.

During the last few months His Excellency the Governor has been in communication with Mr. W. J. Hollier, who has obtained the sole rights for the West Indies of working the Ramie Machine invented by Samuel Benjamin Allison. A public meeting was convened in Kingston for 28th February, by the Jamaica Institute, at the request of the Governor, to hear Mr. Hollier's statements. At this meeting a Committee was formed to go more into details than was possible at a large public gathering. Their report was presented and adopted at a subsequent public meeting on 16th March, and is as follows :—

REPORT OF THE JAMAICA COMMITTEE.

The Committee appointed by His Excellency the Governor has gone very fully into the question of ramie cultivation in Jamaica, with special reference to the Allison Machine, of which Mr. Hollier holds the patent rights for the West Indies.

It has thought it best for the purposes of investigation to divide the subject into three parts—(i.) the cultivation of ramie; (ii.) the treatment of its fibre; (iii.) its commercial value.

All the information obtainable tends to prove that not only will ramie grow freely in a great part of Jamaica, but that it is a plant which is well suited for cultivation by planters and small settlers alike, especially by the latter, as it requires but little original outlay, yields a quick return and the only process which has to be carried out on the spot, retting, is very simple. With good soil and moderate rainfall, or irrigation, ramie will in Jamaica produce four or five cuttings a year.

It is a plant that, if grown thickly, needs little or no weeding; and if the waste liquid from the retting process and the leaves are returned to the ground, but little manuring will be necessary on fairly good land. Hitherto the only obstacle in the way of its successful cultivation on a commercial basis, has been the lack of a machine able to treat its fibre expeditiously.

A low estimate gives 20,000 lbs. of green stalks with leaves, or 5,000 of dried retted stalks as the yield per acre. The minimum product from the dry retted stalks is 15 per cent., or 750 lbs. of raw, merchantable fibre.*

Taking 5,000 lbs. of dried retted stalks† as the yield per acre at each cutting, one acre of ramie would, with but slight expenditure for labour, realize about £4 per cutting; assuming that the cultivator gets but 2-5ths of a cent per lb. for these retted stalks.

Taking 7 cents per lb. as the market price in America of the decorticated ribbon—deducting one cent per lb. for the royalty of the inventor of the machine, and one cent per lb. for various expenses of carriage, commission, &c.—any company which prepared the fibre would net 5 cents per lb. for its decorticated ribbon. It would presumably not offer

* Assuming it to be 800 lbs. per acre it is then 4 per cent. of the green plants.

† The following are the various stages in the manufacture of the ramie :—1. Green stalk. 2. Retted stalks. 3. Decorticated ribbon. 4. Degummed fibre. 5. Bleached fibre. 6. Corded fibre.

more than about $2\frac{1}{2}$ cents for the necessary dry retted stalks, (i.e., about $6\frac{3}{4}$ lbs.) to produce 1 lb. of decorticated ribbon, leaving $2\frac{1}{2}$ cents per lb. to the company to pay for running expenses and profit. Therefore the value of the dried retted stalks is about 2 cents for 5 lbs. It is on this basis that the above-mentioned estimate of £4 per acre per cutting has been arrived at.

The first treatment to which the ramie plant has to be subjected—retting—is one involving but a nominal outlay, no technical knowledge, and but little care. It could be carried out by each settler for himself.

A tank or trough is required of six cubic yards capacity (i. e., about nine feet long, six feet wide and three feet deep) lined with cement, or made of pine-board, with a clay backing. This tank will hold about 3,000 lbs of green stems with the leaves on. Enough water should be added to immerse the stems. To every 1,000 lbs. of stems should be added 5 lbs. of flour of sulphur, 5 lbs. caustic potash and 5 lbs. of good charcoal; but if ashes from the engine be added, half the quantity of potash will suffice. The process of retting is completed in from 4 to 8 days. The bundles when partially open and dried in stacks can be stored, and will keep for a considerable time. The sun would be available for drying in the greater part of Jamaica. The liquid which is over, mixed with cattle, sheep, or horse (not hog) manure, makes a most suitable manure, and the leaves would make good paper stock. The cost of chemicals is nominal. The process of retting could be carried out without the chemicals, but it would take more time.

On the satisfactory performance of the second process, decortivating, depends in great measure the success or failure of the whole industry.

From the nature of things the Committee is not yet in a position to report upon the qualifications of the Allison machine; nor upon the third process, that of degumming, which is a secret, the rights of which, for the West Indies, are also held by Mr. Hollier.

Mr. Hollier states that Sea Island cotton, with which ramie fibre has to compete, never fetches less than 24 cents per lb., and that ramie fibre can, by the Allison machine, be produced to sell at a profit of 24 cents per lb. It now fetches 75 cents per lb.

It is evident to the Committee, from the information before it, that if ramie cultivation is to be successfully carried out in Jamaica, it will be necessary that a factory for the decortivating and degumming of the fibre, should be established in the Island, for the loss on freight on the waste parts of the stalks, if the plants were exported for treatment, would do away with any profit realized by its growth.

It would appear that it would be immaterial to Mr. Hollier whether the company which it would be necessary to form should be formed with Jamaican or American capital. In the first case, Mr. Hollier would claim one-fifth of a capital of £25,000 as promoter's fees. In the latter he would, after he is assured that 2,500 acres of land are planted, be prepared to give a guarantee to take all the ramie grown in the Island. In the first case, Jamaica would stand a chance of making a profit from the treatment of the fibre, as well as from the cultivation of the crops—in the latter she would have no such chance of profit, but would on the other hand run no risk of loss, except through a possible failure on the part of the company to take all the crops produced, for it is obvious that Mr. Hollier's offered guarantee to take all the ramie grown in the Island

would be inseparably connected with the stability of his proposed company. In any case Mr. Hollier proposed to bring shortly an Allison machine to the Island, in order to test its capabilities of treating Jamaica fibres.

Assuming the capacity of the Allison machine to be equal to that which is claimed for it, and that the value of the corded fibre is that stated, the formation of a company to work the machine in Jamaica would be desirable.

The Committee has not thought it worth while at present to weigh the *pros* and *cons* of the formation of a company for working the Allison machine with Jamaican or American capital, as it has not yet sufficient data to go upon.

Of the value of the degumming process the Committee is at present unable to express a decided opinion.

The Committee considers it desirable that before making any recommendations as to the propriety of encouraging planters and others to adopt the cultivation of ramie, or as to the formation of a company to work the Allison machine—the results of the tests to which the Agricultural Department of the United States proposes to subject the Allison machine in the coming autumn should be awaited.

The Committee would suggest that in the meantime the Department of Public Gardens and Plantations should be asked to propagate roots as fast as possible for distribution amongst those planters who may wish to gain some experience in the cultivation of this product, and who may also desire to have a stock of roots on hand if the machine prove successful; as well as to accumulate sufficient stock for a thorough test of the Allison machine when it arrives; and that the Government should be asked whether in the event of a company being formed with either Jamaican or foreign capital, a certain quantity of crown land would be accorded to it, free of rent for a number of years, to place at the disposal of small settlers for the purpose of growing ramie.

The Committee regrets that it has been unable to frame a more decided report as to the value of the processes for treating ramie, from want of more definite information—information which can only be obtained by correspondence. It expresses its willingness to continue as a Committee, to gather such information as will enable it to draw up a decisive report later on, if the public meeting, after it has considered this report, may wish it to do so.

In conclusion, the Committee desires to express its thanks to Mr. Hollier for the valuable information which he has so freely imparted to it, as well as for his promise of further information in the future.

The Committee would recommend that this report should be communicated to the public press prior to the assembling of the adjourned public general meeting.

W. FAWCETT,
Chairman of the Committee
FRANK CUNDALL,
Secretary of the Committee.

The Committee will be glad to receive the names of those who wish to form a Company to work the Allison machine, and of those who will undertake to plant ramie (with statement of area), in case the trials of the machine are satisfactory.

NOTES ON GRAPE VINES.

DISBUDDING AND STOPPING VINES.

By W. J. Thompson of the Department of Public Gardens and Plantations.

As soon as the young growths of the vine are about three or four inches long, disbudding should be attended to, or part of the energy of the plants is wasted on growth that has to be removed to prevent overcrowding.

Young vines grown for field culture should be disbudded to one growth. Those on trellises may be disbudded to one, two, three or four growths as the grower may think fit.

In old vines, main growths can be left from one to an unlimited number as the case may be; but great care must be taken to prevent overcrowding of the main growths.

The first thing to decide in disbudding vines on arbours or trellises is the extreme growth or growths. At this eye cut off all growths but the best one; and the one left is to form the leading growth of that cane; then work down the stem of the vine, on this wood will be formed the fruiting canes or side growths. One good growth should be left about every 15 inches apart to form fruiting canes, all the other growths should be rubbed off. There cannot be any hard and fast rule for the distance between the growths, e. g., if there is about 20 in. of main cane without a growth then there are say two growths about 6 in. apart, leave both; endeavour to arrange so that the main cane has a fruiting branch about every 12 or 15 in. apart. It may seem a waste to some to cut off about four-fifths of the growths, but if this is not done there will be formed a mass of such growths and not one good one among them. If good wood is not secured it is impossible to get fruit.

As soon as disbudding has been done the fruiting or side canes will soon have made growth with seven or eight leaves. As soon as these growths have made about seven leaves they should be stopped; this is done by pinching out the growing point at about the seventh leaf; if no point appears at this stage there will be none this spring, but the vine may fruit a little later on the sublateral growths.

If it should happen that there is not any fruit on this vine when it has made its spring growth it will need just as much attention in the way of stopping, taking off sublateral growth, &c., as if it were bearing a crop. Next year's crop depends on the quality and condition of the wood grown and ripened this year.

I have had several complaints from gentlemen that their vines have not shown any fruit this year. I have examined several vines and in all cases I found that with the heavy rains in the autumn of 1893, the vines had made a lot of superfluous growths, all these had been allowed to remain on the vine so the overcrowding of foliage prevented the fruiting wood—that should have been—from being properly ripened, hence no fruit. Demonstrations on ripe and unripe wood will be given in the autumn.

DISTRIBUTION OF GRAPE VINE PLANTS.

A number of cuttings of the best English Grapes received from the Royal Horticultural Society's Gardens at Chiswick, through the kindness of the authorities at Kew, been grown by Mr. W. J. Thompson in the King's House Grounds by permission of His Excellency the Governor, and rooted plants will be ready for distribution at the end of April.

Application should be made at once to the Director of Public Gardens and Plantations, Gordon Town P. O., stating the number of plants, and kinds required. Plants cannot be promised after April, as they soon spoil by being kept in bamboo pots. The price is 2d. each plant, delivered in Kingston. Special arrangements will be made with those requiring 50 or more.

The following descriptions of the grapes are from a valuable work on the subject, "Vines and Vine Culture" by Mr. Barron, who has charge of the Chiswick Gardens.

ALICANTE:—Fruit quite black, with a thick bloom, large, of a true ovate shape; flesh squashy; flavour somewhat earthy, unless well ripened; skin thick and leathery bunches large, averaging from 2lbs. to 6lbs. in weight, very broadly shouldered, conical and regular closely set; stalk very stout. Late. Very handsome, and easily cultivated.

BLACK HAMBURGH, OR FRANKENTHAL:—Fruit deep bluish-black, covered with a fine bloom, large, roundish-ovate; flesh firm, yet tender, juicy, and with a pleasant, rich flavour; bunches medium, ovate with broad shoulders, compact. A mid-season Sweetwater. This is the chief Grape in cultivation in England.

BLACK MONUKKA:—Fruit purplish-red, small, long-ovate, or in shape like an acorn; flesh firm, tender, seedless, very sweet and pleasant to the taste; branches very large, long-tapering. A distinct Sweetwater variety, of Indian origin.

GROS COLMAN:—Fruit black, with a thick bloom, large, round; flesh thick, coarse, with a poor watery flavour; bunches medium, broadly shouldered, well set. An extremely handsome and excellent keeping, late, vinous Grape.

MUSCAT OF ALEXANDRIA:—Fruit greenish-yellow, golden when highly ripened, large, long-ovate; flesh firm, juicy, sweet and rich, with a high Muscat flavour, bunches large, long-tapering. A very handsome and excellent, late Grape.

RAISIN DE CALABRE:—Fruit white, medium-sized, round; flesh firm, and possessing little flavour; branches long-tapering. A late, vinous Grape, which keeps well.

ROYAL ASCOT:—Fruit purplish-black, large, ovate; flesh very firm with a strong, piquant, plum-like flavour; bunches small, short, compact, well set. A mid-season vinous Grape.

ROYAL MUSCADINE:—Fruit greenish-white, small, round; flesh firm, juicy, sweet, and exceedingly pleasant; bunches small, long-tapering, compact, well set. A good, open air, early Sweetwater Grape, also known as White Chasselas.

TREBBIANO:—Fruit greenish-white, changing to pale amber when fully ripe, large, ovate; flesh firm, sweetly flavoured, but not rich; bunches very large (one example weighing 26½lbs. has been grown) broadly shouldered, well set. A late, vinous Grape.

WHITE FRONTIGNAN:—Fruit greenish-white, small, round; flesh firm, yet juicy and very richly flavoured; bunches medium, long-cylindrical, well set. A mid season Muscat Grape.

FOSTER'S SEEDLING:—Fruit clear greenish-yellow, medium, oval; flesh tender and melting, sweet and pleasant; bunches medium, shouldered, well set. An early Sweetwater Grape.

MADRESFIELD COURT:—Fruit purplish-black, with a fine, grey bloom, large, ovate: flesh firm, yet juicy, sweet and rich, having a strong Muscat flavour; bunches large, long-tapering, well set. A very handsome and excellent, mid-season Grape.

DISEASE AMONG SUGAR CANE.

Copy.

Jamaica.—No. 68.

Downing Street, 24th March, 1894.

SIR,

With reference to my Despatch No. 75 of the 12th of April, 1893, and to Mr. George Massee's pamphlet on the *Trichosphaeria Sacchari*, copies of which have been recently sent to you through the Crown Agents for the Colonies, I have the honour to transmit to you a copy of a letter from the Director of the Royal Gardens, Kew, stating that the evidence regarding this disease goes to show that it is new to the West Indies, and pointing out the importance of bearing this fact in mind.

I also enclose a copy of a further letter and enclosure from the Director of Kew Gardens, which will enable you to realise the extreme gravity of the situation.

I have, etc.,

RIPON.

Governor Sir H. A. Blake,
&c. &c. &c.

Copy.

Royal Gardens, Kew,
March 12th, 1894.

SIR,

I have the honour to inform you that I have received a copy of the Supplement to the Leeward Islands Gazette for January 11th, 1894, containing "A Report on Diseases affecting the Sugar Cane in Barbados," by Mr. C. A. Barber, the Superintendent of Agriculture.

2. In this paper, p. 108, Mr. Barber states:—"The fungus (*Trichosphaeria*, which is the cause of the most serious disease) has been detected in specimens in the Kew Herbarium 40 years old from the West Indies, and we may therefore at once assume that it is no recent importation." I think it is important to point out for the information of the West India Governments interested in the matter, that this statement is founded on a mistake. There is no evidence at Kew of the existence of this particular disease in the West Indian Sugar fields prior to 1892. There is a specimen at Kew of Sugar Cane collected in Mexico 40 years ago attacked by the moth borer, and this may be what Mr. Barber has in his mind.

3. The evidence in my opinion goes to show that the *Trichosphaeria* has made its appearance quite recently in the West Indies, and I have little doubt that it has been introduced from the Old World.

The importance of clearly recognising the actual fact can hardly be overrated. It is obvious that if the disease has existed comparatively unnoticed in the West Indies for 40 years it is unlikely to suddenly assume the dimensions of a scourge. If, on the other hand, it is a comparatively recent introduction, the possibilities of the mischief it may effect have still to be measured.

I have, etc.,

W. T. THISELTON DYER.

Edward Wingfield, Esq., C.B.,
Colonial Office.

Copy.

Royal Gardens, Kew, March 19th, 1894.

SIR,

With reference to previous correspondence on the subject of the sugar cane disease in Barbados, I have the honour to inform you that I have carefully discussed the situation with the Governor of the Colony, and at his request have furnished him with the letter, of which I enclose a copy, which he will lay before his Executive Committee.

* * * *

No doubt the Secretary of State is fully informed as to the actual position. Nevertheless he will probably be glad to have the enclosed documents submitted to his consideration.

I am, etc.,

W. T. THISELTON DYER.

Edward Wingfield, Esq., B.C.L., C.B.,
Colonial Office.

Copy.

Royal Gardens, Kew, 19th March, 1894.

MY DEAR SIR JAMES,

I willingly assent to your request to put in writing my views as to the danger which appears to me to menace the Sugar industry in Barbados.

2. I do not wish to be an alarmist. But in a matter of this kind it is better to take a gloomy view than a too sanguine one. The former may at least lead to the adoption of timely precautions, the latter may lull the planters into a false sense of security till it is too late to apply any effectual remedy.

3. There are now two definite diseases due to fungi amongst the Sugar Canes in Barbados, and probably elsewhere in the West Indies. One affects the stems (*Trichosphaeria*), the other the roots (*Colletotrichum*). The former is the more serious probably. It is fortunately easily recognized, and no effort should be in my opinion spared to stamp it out or at any rate keep it under control.

4. An opinion has been expressed that it has existed for a long time in the New World. If this were the fact it might be argued that there is no great cause for alarm, as it is improbable that it would suddenly assume an unwonted activity. I believe however that the opinion is based on a mistake. All the evidence points to the fact that both diseases have been introduced comparatively recently into the West Indies from the sugar-growing countries of the Old World.

5. It is an undoubted but unfortunate fact that while a disease may exist for a long time in what may be considered its native country and do comparatively little mischief, when introduced into a new one, it may develop the greatest virulence. It is for this reason that I view with alarm the present outlook in Barbados. The *Phylloxera* of the vine affords a case in point. In the New World it inflicted little appreciable damage on the native American vines. When introduced into Europe it spread like wildfire. It can hardly be doubted that it will exterminate the vine of the Old World, which will ultimately only be able to exist when grafted on the stocks of American species.

6. What disasters a disease like that which has attacked the Sugar Cane can produce is painfully illustrated by the case of coffee in Ceylon. In 1874-75 that Colony exported a little under a million cwts. of coffee, in 1892 the export had sunk to 43,143 cwts. or less than a twentieth. This was the result of the leaf disease. Ceylon, however, had other resources and it was able to replace the industry, which had been destroyed first by cinchona, and secondly by tea.

7. The circumstances in Barbados are widely different. If Sugar cultivation fails, I am quite at a loss to know what is to take its place. You have, I understand, a population of 172,000 or 1,000 to the square mile, practically dependent on it. It is painful to contemplate even the possibility of the disaster which a failure of Sugar cultivation may inflict on the Colony.

8. I strongly approve of your suggestion to immediately obtain the appointment of a strong Committee to consider the position. Such a Committee should at once take the following steps into serious consideration :—

I. Appointment of a competent and practical man with local knowledge to take charge of the executive side of the whole matter. He would travel about the Island inspecting the canefields, make himself thoroughly acquainted with the whole subject, and watch the progress of the disease and the effect of remedial measures.

II. Obtaining compulsory powers to stamp out the disease wherever it appears. To do this effectively it will no doubt be necessary to give moderate compensation. Diseased canes should be destroyed by burning on the spot and not unnecessarily carried about. Care should be taken that the clothes of the men employed on the work are not made the vehicle for carrying the spores to uninfected cane fields.

III. When a field has been badly infected and the canes have been destroyed, it should be cropped with some other plant which must not be maize, guinea-corn, or any gramineous plant, in order to let the spores which have been left in the ground exhaust themselves.

IV. A central station should be started for supplying "tops" and "seed cane" of guaranteed healthiness to the planters.

9. You will observe that the general idea is to stamp out the disease at all costs.

Believe me, etc.,

W. T. THISELTON DYER.

Sir James Shaw Hay,
84 Gloucester Place, Portman Square.

FERNS : SYNOPTICAL LIST.—XXVI.

Synoptical List, with description of the Ferns and Fern-Allies of Jamaica, by G. S. Jenman, Superintendent Botanical Gardens, Demerara, (continued from Bulletin, Part 2).

30. *Asplenium Scandicinium*, Kaulf.-Rootstock upright, clothed with firm hairlike brown scales; stipites tufted, naked, light-green 6-10 in. l; rachis similar; fronds pendent, $\frac{3}{4}$ -1 $\frac{1}{2}$ ft. l. $\frac{1}{2}$ - $\frac{2}{3}$ as wide, ovate-lanceolate, acuminate, tri-quadrifid, thin, clear light green, pellucid naked; pinnæ subdistant, lax similar in shape to the frond, 3-5 in. l. nearly as w. acuminate, rather long petiolate; pinnulæ and final segments petiolate, the latter cuneate-rhomboidal, 4-6 li. l. and w. incised the end blunt, $\frac{3}{4}$ -1 li. w.; veins radiant, forked, no main rib; sori 1 $\frac{1}{2}$ li. l., also radiant, involucres pale, thin.—*A. adiantoides*, Raddi.

Gathered only by Dr. Macfadyen, the locality not recorded whose specimens are in the Kew herbarium, from which the above description was drawn up. Resembling *cuneatum* in general outline, but the final segments much larger, thinner, flaccid, and paler.

31. *A. myriophyllum*, Spreng.-Stipites, erect, $\frac{1}{2}$ -1 ft. l. naked, green-margined gray or darker when dry, tufted on a fibrous finely-scaly rootstock; rachis conform; fronds oblong or ovate-lanceolate, bitripinnate, $\frac{3}{4}$ -1 $\frac{1}{2}$ ft. l; $\frac{1}{4}$ - $\frac{1}{2}$ ft. w. acuminate, abruptly reduced at the base to small dwindling multifidly cut pinnules, membranous, bright green, glossy, naked; pinnæ numerous horizontal, approximate or subdistant, oblong-lanceolate, sessile, 1 $\frac{1}{2}$ -4 in. l. $\frac{1}{2}$ -1 in. w. acuminate or rarely obtuse; pinnulæ close, $\frac{1}{4}$ - $\frac{1}{2}$ in. l. deeper on the outer side, oblong, broadly obtuse, pinnate; final segments linear or elliptical, 1-2 li. l. $\frac{1}{2}$ - $\frac{3}{4}$ li. w., the inferior united and emarginate; veins simple in the segments or lobes, in which the sori which are $\frac{1}{2}$ -1 $\frac{1}{2}$ li. l. and lateral on the veins are also single; involucres pale, thin.—Eat. Fer. N. Am. pl. 51. *Cænopteris myriophyllum*, Swartz.

Common at 4000-5000 ft. alt on wet rocks and banks of streams, in forests and woody places; more compound than the form figured by Eaton as found in the Southern States. Distinguished from *cicutarium* which it most resembles by the more deeply cut, fully pinnate pinnulæ,—hence free final segments, the basal of which overlap the rachis, and by the much reduced lower pinnæ, the two following species however having also the latter feature.

32. *A. monteverdense*, Hook.—Stipites tufted on a small upright and minutely scaly rootstock, very slender, grayish, 1-5 in. l. channelled narrowly membran-margined, fronds tripinnate, lanceolate oblong, membranous, naked, slaty-green, 3-8 in. l. 1-2 in. w. acuminate, the base reduced; pinnæ spreading, contiguous or apart, the reduced lower ones rather deflexed, sessile, oblong or lanceolate-oblong, mostly obtuse, $\frac{1}{2}$ -1 in. l. $\frac{1}{4}$ - $\frac{1}{2}$ in. w.; larger pinnulæ pinnate subflabellate and cuneate; final segments simple but confluent at the base, obovate-cuneate, emarginate, 1 li. l. $\frac{1}{4}$ - $\frac{1}{2}$ li. w., obtuse, a solitary vein and sorus to each, the latter $\frac{1}{2}$ li. l., elliptical at maturity and lateral on the veinlet; involucres pale, half elliptical.—Hook. 2nd Cent. Ferns, t. 41.-Sl. t. 52. f. 3.

Var. *Shermaniana*, Jenm.—Stipes and fronds shorter, the latter hardly reduced at the base; pinnules pinnate, flabellate; final segment

more confluent, shorter and more ovate, not incurved ; basal ones often rather recurved.

Frequent or infrequent in localities in Manchester and other of the central parishes, on the sides of rocks in woods and other shaded places. Resembling *myriophyllum* in form and cutting, but uniformly much smaller, different in colour, and with the final segments rather curved or falcate when single. Rather more finely cut than Hooker's figure cited above shows. By spreading on one side of the veinlet the sori appear quite lateral. When the involucre are concealed by the matured sori, the plant looks like a delicately cut *Gymnogramme*. Wright 1,029, Mount Verde, Cuba. The variety which is smaller, and not dwindled at the base was found, once only, in St. Andrews Parish near Mount Moses by the Rev. Sherman B. Wilson in 1874.

33. *A. rhizophyllum*, Kunze. Stipites slender, tufted on a small fibrous, usually upright, root-stock, $\frac{1}{2}$ -3 in. l. channelled, margined, brown or dark-green, naked ; rachis similar ; fronds lanceolate or oblong-lanceolate, 6-10 in. l. 2-3 in. w. bitripinnate membranous, dark green, rather glossy, naked often viviparous and radicate at or near the acuminate apex, gradually reduced at the base ; pinnæ nearly horizontal close or subdistant, nearly or quite sessile central 1-1 $\frac{1}{2}$ in. l. $\frac{1}{2}$ - $\frac{3}{4}$ in. w. the slender costæ terminating in small spatulate, bi or trilobed segments pinnulæ cuneate-stipitate, composed of several lax cuneate-flabellate, spatulate, obtuse final segments $\frac{1}{2}$ - $\frac{3}{4}$ li. w. when single ; veins and sori single in the final lobes, the latter $\frac{1}{2}$ li. l. half elliptical ; involucre thin membranous.

Var. *diminutum*, Jénm. Variable delicate, lax, prostrate, 1-2 in. l. $\frac{1}{4}$ - $\frac{1}{2}$ in. w. rooting at the end ; lobes of the short pinnæ few, spatulate.

Frequent in caves and on and under rocks in sheltered places at 5,000 to 6,000 ft. alt., common about the top of John Crow Peak. The stipitate pinnulæ and segment, which give a loose aspect to the cutting rounded more spatulate lobes proliferous rachises, and fronds reduced equally from the middle both ways, are its distinguishing features. The rachises are leafy to the end, the buds when present being produced within the apex. Some confusion exists as to its identity. Hook and Grev. Icon. Fil. t. 193, under this name, is *A. lunulatum*, var. *strictum*. The variety is from the caves of John Crow Peak, and is fertile from least to great of its varying stages.

34. *A. cicutarium*, Swartz. Stipites cæspitose from an upright fibrous, scaly, root-stock, 4-9 in. l. gray-green or darker coloured, green-margined, naked ; rachis similar, fronds bitripinnate, lanceolate-oblong, $\frac{3}{4}$ -1 $\frac{1}{2}$ ft. l. 3-6 in. w. membranous, light green, glossy, naked, broadest at the truncate base, acuminate ; pinnæ numerous, oblong-lanceolate, nearly horizontal, close, or the lower subdistant, sessile, acuminate, 2-3 $\frac{1}{2}$ in. l. $\frac{3}{4}$ -1 or more w. pinnulæ ovate-oblong, close, lowest pair of the lower pinnæ reduced, broader and deeper on the exterior side, 5-8 li. l. 3-4 li. b. at the obliquely cuneate base ; final segments emarginate or the interior ones tri or quadridentate, the teeth sharp and $\frac{1}{3}$ - $\frac{1}{2}$ li. w. in which the veins are simple ; sori copious, "uddy, one to each ultimate segment, half elliptical-oblong, less than a li. l. ; involucre pale, thin, conform.—Sl. His. p. 92. Herb. p. 122. Pl. t. 48. A. Eat. Fer. N. Am. pl. 56.

Frequent on wet rocks along river courses among the lower hills; marked from the four preceding by the fronds being invariably truncate and usually widest at the base, and the sharper-toothed less deeply cut, pinnules, in which the sori though one to each tooth, are chiefly on the disk within, extending thence into the base of the serratures. The basal pinna though close to, do not overlap the rachis as in the allied species. The rusty ruddy character of the abundant sori first mentioned by Sloane, is a beautiful and characteristic feature.

35 *A. rutaceum*, Mett.-Stipites caespitose from a small upright fibrous and a brown scaly root-stock, short (hardly any clear of the dwindling pinnæ) channelled, polished, dark brown; fronds oblong-lanceolate, tripinnate, 10-15 in. l., 3-4 in. w., thinly membranous, grass green, naked, rachis prolonged beyond the acuminate apex into a delicate threadlike naked green tail 2-4 in. l. radicant at the end; pinnæ horizontal, sessile, oblong-lanceolate, $1\frac{1}{2}$ -2 in. l. 6-8 li. w., the rather flexuous flattish slender green costæ generally terminating like the rachis but not prolonged; pinnulæ obliquely cuneate, stipitate, composed of 2-4 laxly spreading acute-obtuse subspathulate or oblong final segments which are $1\frac{1}{2}$ -2 li. $\frac{3}{4}$ li. b., with a single vein and sorus to each, the latter half elliptical, lateral; involucre thin, the shape of the sori. Hook. 2nd Cent. Ferns. t. 34. Pl. t. 57.

Frequent on rocks and banks by shady river courses in moist districts from 2000-4000 ft. alt. A delicately thin species, resembling the preceding in general cutting, tapering equally both up and down with hardly any clear stipes, and terminated with a naked filiform tail which roots eventually at the end, as in *rhizophorum*. In Plumier's figure the tail is not represented, and the sori appear round, hence Willdenow's mistake in placing it in *Aspidium*.

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SEEDS.

From Royal Gardens, Kew.

Raphia Hookerii, *Vaccinium maderense*, *Taxus baccata*, *Taxus baccata*, fructu-luteo, *Pinus Peuce*, *Syringa vulgaris*, *Syringa pekinensis*, *Biota orientalis*, *Biota orientalis*, intermedia, *Biota orientalis*, pyramidalis, *Biota orientalis*, gracilis, *Cupressus Lawsoniana*, *Cupressus Thyoides*, *Cupressus nootkatensis*, *Retinospora obtusa*, *Chrysanthemum segetum*, *C. carinatum*, var. *atrococcineum*, *C. coronarium album*, *C. coronarium fl. pl.*, *C. cinerariifolium*, *Datura laevis*, *Dahlia variabilis*, *D. coccinea*, *Nicotiana Langsdorffii*, *N. rustica*, *N. paniculata*, *Cuminum Cyminum*, *Primula obconica*, *P. japonica*, *Mimulus moschatus*, *Physalis Alkekengii*, *Gunnera scabra*, *Gnaphalium indicum*, *Funkia ovata*, *F. Sieboldiana*, *F. lancifolia*, var. *marginata*, *Viola sylvatica*, *Atropa Belladonna*, *Hemerocallis flava*, *Coriandrum sativum*, *Helichrysum bracteatum*, *H. b. var. luteum*, *H. b. var. album*, *Cucumis Melo*, *Alphitonia excelsa*, *Eucalyptus coccifera*, *E. Risdoni*, *E. urnigera*, *E. Gunnii*, *Bauhinia Hookerii*, *Athrotaxis cupressoides*, *Styrax Benzoin*.

From Botanic Gardens, Bangalore.

Bignonia indica, *Withania somnifera*.

From Botanic Gardens, Lagos.

Daniellia thurifera.

From Govt. Botanist, Melbourne.

Callistemon speciosus, *Clerodendron tomentosum*, *Frenela columellaris*, *Grevillea robusta*, *Heptapleurum venulosum*, *Hymenanthera angustifolia*, *Melaleuca hypericifolia*, *Nephelium leioleucum*, *Panax elegans*, *Sterculia heterophylla*, *Sterculia acerifolia*, *Syncarpia laurifolia*, *Tristania conferta*.

From Botanic Gardens, Saharanpur.

Swertia mixed spp., Jalap tubers.

From Botanic Gardens, Demerara.

Manihot Glaziovii, *Borassus flabelliformis*.

From Admiral Ammen, Washington, D.C.

24 pkts. miscellaneous seeds.

*From Botanic Gardens, Trinidad.**Livistona altissima*, *Cassia marginata*.*From Botanic Gardens, Rio de Janeiro.**Crotolaria semperflorans*, *Luffa cylindrica*, *Indigofera Anil*, *Acacia leucocephala*, *Cassia Tora*, *Sesbania Paulensis*, *Urena lobata*, *Swartzia crocea*, *Mucuna pruriens*, *Adenanthera pavonina*.*Mr. C. L. Walker, Walker's Wood.**Euphorbia* sp.*Miss Roberts, Gordon Town.**Hibiscus Bancroftianus*.*Hon. J. W. Fisher, Stewart Town.**Dendrocalamus strictus*, Nees. (Cutting.)*Miss Burke, Kingston.**Stephanotis floribunda*.*Miss F. Maclaverty, Greenwich.**Tritonia* (*Monthretia*) tubers.*Mr. S. Soutar, Kingston.*Ivory nut. (*Phytelephas macrocarpa*.)

PLANTS.

*Miss Fisher, Stewart Town.**Epidendrum fuscatum*.*Mr. R. K. Tomlinson, Lacovia.*

Accom yam (Tubers.)

Hon. J. M. Farquharson.

Accom yam (Tubers.)

JAMAICA.

BULLETIN

OF THE

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New Series.]

MAY, 1894.

Vol. I.

Part 5.

CALABASH AND ABORTION IN CATTLE.

The publication of the following correspondence may induce those who take an interest in the subject to continue enquiries. There seems to be considerable doubt about calabash being the cause. It is quite possible that the true cause may be the presence of an ergot on the flowers of the grasses. The ergot of the pharmacopœa is a fungoid body, which is parasitic on common rye, but it also attacks wheat, barley and a number of other grasses. A grain of rye attacked by the fungus has its tissues destroyed, and is converted into a hard oblong body $\frac{1}{2}$ – $1\frac{1}{2}$ inches long, of a purplish colour outside, white internally, but the size varies with the grass, and is generally smaller.

Mr. C. A. T. Fursdon to Director of Public Gardens and Plantations.

I have lost some twenty calves this year through abortion, and have been unable to discover the cause, which I expect is some plant that the cows eat in the pastures. An old man now tells me that it is the common calabash (*Crescentia Cujete*), which I see in your list of Economic Plants you state is a purgative.

Can you tell me if this tree has been known to be eaten with the above effect, as if so I shall certainly have all here destroyed, or is there any other tree or plant known to produce abortion in stock.

Director to C. A. T. Fursdon, Esq.

"The only reference I can find to your question is in Barham's *Hortus Americanus*, who says:—"It is said that the pulp, if eaten, will make a cow cast her calf, or a mare her colt. It is certainly known (if not too well known) to be a great forcer of the *menstrua* and of the birth and after-birth, therefore ought to be very cautiously given or taken." This refers to the common calabash.

I will make enquiries and see if anything is generally known of this property, but it certainly seems advisable to cut down all the calabash trees in your pastures."

Mr. J. W. Edwards to Director.

In answer to your enquiry about abortion in cows and mares, I cannot say that I know of the calabash or any other plant in this country, when entire, producing such unfavourable results.

At this property we have had but occasional cases, and I advocate on the first appearance of a case of abortion in any pasture to remove the cow or mare from the other animals, as it is of a sympathetic nature."

Mr. J. P. Clark to Director.

"I cannot say I have ever suffered from cows casting their calves through eating calabash, of course I have had cases, and will observe in future if one occurs whether it is in the calabash season."

Mr. Henry Maxwell to Director.

"I have several calabash trees growing on the common here (Friendship) and have noticed the cows eating the pulp with no bad effects. I made enquiries of several of the oldest black headmen in the adjoining properties and they also have never experienced it or heard of its having that effect. I do not know of any plant that causes it in either case. I have had a few cases amongst cattle in very hot and dry weather and attributed them to that coupled with bad water causing poverty in the animal."

Mr. J. I. Cohen to Director.

"Referring to your letter in reference to question of calabash pulp, I have spoken to two of my managers, practical men, and both say they have never known such a thing though it is well known that the pulp of the young calabash is used by people for cleaning their bowels after a fall and the leaves I believe are used by women for tea for forcing the *menstrua*. It is well known that if a cow or several cows happen to see one cow cast her calf, that they are also likely to do the same and if a mare should see the dead carcass of a cow or horse in a putrid state she is likely to cast her foal. This is all the information I can give you on the subject."

Mr. Stafford Maxwell to Director.

"I have never known a cow cast her calf or a mare her foal from eating calabash. I had a cow at Northampton that always ate the calabash from the trees, and she calved every year. The pulp boiled is a very strong purgative, and if given to either cows or mares when they are heavy in young, it will bring on abortion. If there are several cows in calf or mares in foal, and one casts its young, the others will too, if allowed to remain in the same pasture, brought on from sympathy. Mares also cast their foals from bad smells, and very dry Guinea grass."

Mr. C. L. Walker to Director.

"I have a great quantity of the common calabash at Ballards Valley in St. Mary, and must certainly say that my breeding cows of which I keep a good number there have not suffered in the way you mentioned. Probably it is the wild calabash and not the common one which causes abortion among cattle."

Mr. A. C. Kennedy to Director.

"I have lopped calabash trees in Manchester for my cattle during

the dry seasons, and never noticed any ill effects on the cattle. My father, the late Alan Kennedy of Somerset, in the Parish of Manchester, pointed out to me a mistletoe then growing on a Timber Sweetwood Tree, which had a small longish leaf which he said would cause an abortion in cattle, and not much of it would be required, say about a handful or a couple of good mouthfuls."

Mr. E. W. Muirhead to Director.

"With reference to the calabash producing abortion in cattle and horses, during my experience I have heard of cattle being affected in this way, but not horses. Just lately Mr. D. mentioned to me the loss of a few calves which he attributes to their eating the calabash. Cattle and other stock are very fond of the calabash and feed on it in dry weather. I may also mention that the bush of the Red peas, bean, Guango trees affects horses, asses, &c."

Mr. J. Shearer, Duncans.

"I received yours about the supposed effects of the fruit of the calabash tree. Knowing very little about the matter myself I have consulted several parties having experience in stock-breeding. Enclosed is a note from Dr. Dewar and one from my Overseer at Drax Hall Estate. Dr. Dewar says the calabash is not known as an emmenagogue among the natives of Jamaica, but I have been informed by another that it is used for such purposes by the natives of Hayti. Abortion among cows is catching or sympathetic, and if one cow leads off in presence of others in the same condition several may follow suit."

"I do not see how the abortions can be attributed to the eating of calabash, for as you know the cattle by the seaside Pens eat it commonly it being plentiful and feeding short at times of the year.

I am sure it is not known amongst the negroes as an emmenagogue. This is the first I have heard of this property as pertaining to calabash.

G. P. DEWAR."

"Regarding the calabash causing cows to cast their calves I have never heard of it before. I have seen them eating the fallen ones, and taking them from the lower branches, and cattle seem to be fond of them.

I enquired of a couple of old men here, but they know of no other use of the calabash more than for colds, and in cases of a severe fall the juice is given with castor oil.

JOHN ELLIS."

•Mr. J. W. Fisher to Director.

"I have been making enquiry as to the effects of the calabash pulp or juice on cattle or horses, but have failed to obtain any information corroborating Barham's mention that it causes abortion. It is, however, generally used by the creole midwives to assist in bringing away the after-birth in child-bearing—and is considered a great forcer of the *menstrua*. It is also often used in cases of a severe fall—given mixed with oil and vinegar

With regard to the instance you allude to of a large number of

calves having been lost through abortion, I should think it was caused through sympathy, as it is well known that when one cow in a pasture casts her calf, several others feeding along with her are very likely to do the same."

Mr. DeB. Spencer Heacen to Director.

"I may say that I believe I have lost calves in consequence of the cows being placed in paddocks where they were able to get at the fallen green calabashes. Recently two cows were placed in a pasture where there happens to be plenty of calabash growing, and both slipped their calves, which were well advanced. I have known for some time that the negroes used calabash juice for cases of hard labor and also for other purposes, but was not aware that it had so powerful an effect in breeding stock as that mentioned by Barham in his *Hortus Americanus*.

A syrup of calabash juice and white sugar is an excellent remedy for coughs, either common or consumptive, so the calabash has its beneficial uses if it is deleterious for stock that are breeding."

Mr. Adam Roxburgh to Director.

"I cannot say that it has ever come under my own observation that calabash eaten by an animal when carrying will cause abortion. Like your correspondent, however, I have, during the past month, had no less than four cases of abortion amongst my breeding cows. I have enquired of my cattlemen as to whether they have noticed the cows eating calabash, but they have not seen them doing it, though we know that the cows do eat the pulp sometimes, and it is quite possible that they may have been doing so lately.

The pulp of the calabash is used also by our peasantry as a cure for colds and sprains. Now it is likely that it acts by contracting the blood vessels round the bruised parts, and it is just as likely that it would act in the same way on the womb, and by the contraction of the organ cause abortion. Hence it is very probable that Barham is quite correct in what he says."

ROBT. WALLACE'S FARM LIVE STOCK OF GREAT BRITAIN, in a chapter on "*Cows and their Management*," states:—

"Causes of Premature Labour—

1. Eating ergotised grass in autumn.
2. Injury, as from horning by other cattle, hunting by dogs, crushing through narrow doorways, staking and bruising on a railway journey, &c.
3. Walking through a dung heap, or over boggy or soft land, and getting strained.
4. Very cold or foul water, or too many frosted turnips, especially if given in the house while the animal is not moving freely about.
5. Superpurgation, either natural or induced by physic.
6. Any contagious febrile disease of a serious character; for example, infection arising from association with newly aborted cows which are affected with contagious abortion, or from bad animal smells.

"The last is perhaps more common and dangerous than all the

others put together, because its work is done unseen, and it often cannot be easily avoided, even when its presence is detected."

GEO. ARMATAGE in "EVERY MAN HIS OWN CATTLE DOCTOR." (—6th Ed., 1890), writes as follows:—

"Abortion frequently proves a source of continued loss and anxiety to the stock breeder, from the numerous instances in which pregnant animals expel the foetus after one of their number has committed the act, the malady appears to run through the herd with almost electric celerity, and, in some instances, even particles of enzoötic characters, from which it has been considered to possess contagious properties. We are, however, now certain that such a conclusion is an erroneous one, and can confidently account for the disease in excessive plethora, presence of pugnacious animals, disposition to chase each other, derangement of digestive or urinary organs, leading to violent straining, colic, &c., as well as blows, falls, leaps, &c., and all such influences that are likely to sever the connection between mother and foetus. These may be termed vital and mechanical causes.

Professor Tanner—in '*Veterinary Review*,' Vol. I.—maintains, this disease occurs in more instances than are either discovered or admitted, from the effects of the ergot of rye-grass, to which is awarded similar ecboic properties as are supposed to obtain in the ergot of rye. A humid atmosphere or wet season, he, states, are required to produce the ergot upon fully ripened seeds. This, however, fails to account for abortion, which occurs as often in dry seasons. . . .

"Abortion is *not* a contagious disease as applied by the term in the sense in which it is always used. The rapidity and certainty with which animals successively abort, is, doubtless, caused by a morbid nervous excitement, of which the cow is particularly sensible, inducing a general uneasiness in which premature contraction of the womb is ensured, or detachment of the usual means of connection between mother and foetus, and consequently, death of the latter. Enzoötic forms of abortion, doubtless, arise from the peculiarity of vegetation during certain seasons, as well as by bad smells, the result of some local putrifaction, a morbid sensitiveness in the cow favouring a wild excitement, which deranges the contents of the uterus, and perpetuates the disease in a herd. When it occurs in cattle exclusively housed, it may be generally traced to defective drainage, and sometimes to inoculation by putrefactive germs coming in contact with the mucous membranes of the genital organs. In this instance, the embryo or foetus doubtless dies from a faulty condition of the blood.

COCCIDÆ, OR SCALE INSECTS.—V.

By T. D. A. COCKERELL, Professor of Entomology at the New Mexico Agricultural College.

(20.) *Lecanium urichi*, Ckll. (The Ants'-Nest Shield-Scale).

Diagnosis.—About the size and shape of a half-pea, but somewhat smaller and flatter; red-brown, very shiny, with black or blackish interrupted lines indicating the segments. Legs and antennæ apparently absent in the adult female.

Distribution.—Only known from Trinidad, where it was discovered by Mr. Urich.

Habits.—Found in the nests of an ant, the *Cremastogaster brevispinosa* of Mayr.

Destructiveness.—The food-plant is unknown, but it may be assumed that the insect is not seriously destructive.

(21.) *Lecanium begoniæ*, Dougl. (The Begonia Shield-Scale).

Diagnosis.—In shape similar to the last, but only about an eighth of an inch long; shiny, so dark brown as to seem black. The scale is not equally convex in each direction; consequently, the outline as seen from the side is pyramidal, while seen from the end it is rounded. This scale, from its very different habitat, is not likely to be confounded with the last; but should any doubt arise it may be set at rest by examining the substance of the scale by transmitted light under the microscope. In *urichi* it presents numerous large round gland-spots, but in *begoniæ* it consists of distinct oblong plates, each having a gland-spot in its centre.

Distribution.—Originally from Demerara, but since found by Mr. Barber in Antigua.

Food-plants.—*Begonia* in Demerara, *Terminalia* in Antigua. Probably it will be found to infest various plants.

Destructiveness.—It is likely to be troublesome in gardens.

Enemies.—It is severely attacked by a Chalcidid parasite in Antigua. On one leaf, 22 out of 35 scales showed parasite-holes. The parasite appears to represent a new species.

(22.) *Lecanium depressum*, Targ. (The Hibiscus Shield-Scale).

Diagnosis.—Like the last, except in shape, being twice as long as broad. Dark chocolate brown, very shiny, convex, having the dermis finely reticulate, as in *begoniæ*.

Distribution.—First found on cultivated species of *Ficus* at Florence, Italy, and in Paris. Mr. Maskell reports it from plants in green-houses in New Zealand; also from Australia, and the Sandwich Islands. In the West Indies, it was first found by Mr. Barber on *Hibiscus* in Antigua; recently Mr. Urich has detected it on the same plant at Port-of-Spain, Trinidad. } *de*

Food-plants.—Various; *Hibiscus*, *Ficus*, *Hakea*, guava, bamboo, &c.

Destructiveness.—It is undoubtedly a serious pest wherever it becomes abundant. Mr. Barber remarked that it was enormously fertile.

Remarks.—Mr. Maskell, of New Zealand, is of opinion that this, *L. begoniæ* and *L. nigrum* of Nietner all represent different forms of a single species; which, according to the law of priority, must be called *L. nigrum*. While I am not altogether prepared to accept this view, it must be admitted that they are at least very closely allied, and it is important to bear in mind the possibility or probability of their specific identity.

Lecanium nigrum has hitherto only been known from India and Ceylon, where it attacks coffee. According to Mr. E. E. Green, however, it is seldom found on coffee, though "sometimes present in large numbers upon the Croton-oil plant and the Ceara rubber, where it produces the usual effect, viz., a heavy fall of leaf and black fungus."

(23.) *Lecanium hemisphaericum*, Targ. (The Brown Shield-Scale.)

Diagnosis.—Small, very convex, hemispherical, reddish-brown, usually crowded together on the plant.

Distribution.—Very widely distributed, being found in Europe, the United States, New Zealand, Australia and the West Indies.

Food-plants.—Very various; *Ixora*, peach, orange, oleander, camellia, *Dracæna*, orchids, chrysanthemum, *Anona muricata*, *Salvia*, *Eranthemum*, *Dendrophthora cupressoides*. *Tabernæmontana coronaria*, *Cycas*, guava, *Terminalia*, &c.

Destructiveness.—Extremely injurious in gardens, especially on shrubs and creepers; the number of different plants it is liable to infest and its powers of rapid multiplication, make it very difficult to fight. In Jamaica it abounds in the gardens of Kingston, and has been found also at Cinchona, Port Antonio and other places. In Antigua Mr. Barber found it a "terrible pest to variegated *Eranthemum*," and also sent a single scale on a leaf of *Terminalia catappa* (associated with *L. oleæ* and *L. begoniæ*), and a pale variety on *Salvia*. Mr. Barber also reports it from Montserrat, where it infests *Cycas*. In Trinidad it is found at Port-of-Spain on *Eranthemum*; also at San Fernando on a garden plant not specified.

Enemies.—It is remarkably free from the attacks of parasitic or predaceous insects, but fortunately succumbs to a fungus. This fungus was found by me on scales infesting *Tabernæmontana* in Col. White's Garden in St. Andrew, Jamaica; it is a white growth, which mummifies the scales, and is probably a state of some *Cordyceps*. Curiously enough, the same or a very similar fungus was described by Mr. Barber as infesting the scales in Montserrat at about the same time (March-April, 1893) as my account of the Jamaica fungus first appeared; Mr. Barber's article, together with a reprint of mine, will be found in the *Supplement Leeward Islands Gazette*, 22nd June, 1893.

Variety hibernaculorum, Boisduval.—This is larger than typical *hemisphaericum*, but it seems clear that Boisduval and Signoret were mistaken in supposing it a distinct species. It is reported to occur on many different plants; *Brezia*, *Phajus*, &c., especially in greenhouses. Coquillett reports it from pear and orange; in Demerara it is recorded with some doubt as found on *Cyrtanthera*. Mrs. Swainson sent me a single specimen large enough to be referred to *hibernaculorum*, which she found on a fern in Jamaica.

The Brown Scale on Coffee.—Many years ago the English Entomologist Walker described *Lecanium coffeæ*, a species injurious to coffee in India and Ceylon. It is likewise found on the tea-plant, but whether it infests garden plants does not seem to have been ascertained. In Ceylon it lives at altitudes above 3,000 ft., and is supposed to be destroyed by red ants.

Signoret describes it from specimens sent to him from Bahia, Brazil, where, he says, it appears to cause great havoc in coffee plantations.

Mr. Barber, in the article above-mentioned, reports *Lecanium hemisphaericum* as injuring coffee in Montserrat; with it is found a small red ant, *Tatramorium auropunctatum*. The facts given by Mr. Barber would at once suggest that he had *L. coffeæ*, but he is familiar with the *hemisphaericum*, and would have made no mistake; besides which he sent specimens to Prof. Riley, the U. S. Entomologist, who confirmed his identification. The explanation of this circumstance is fairly evident, namely, that *hemisphaericum* and *coffeæ* are one and the same species. The close resemblance between them has long been known,

and on comparing the description given by Signoret, and the various figures published by Mr. Green of Ceylon, I can scarcely doubt the identity.

(24.) *Lecanium filicum*, Boisd. (The Fern Shield-Scale).

Diagnosis.—Like the last, but somewhat smaller, with the sides more or less furrowed. Young specimens are white.

Distribution.—Found on ferns in Kingston, Jamaica; also in the United States, Europe and Australia.

Food-plants. Various ferns; *Pteris*, &c.

Destructiveness.—Troublesome in gardens and hothouses.

Remarks.—It is doubtful whether this species is distinct from the last, which is also sometimes found on ferns.

(25.) *Lecanium oleæ*, Bern. (The Black Shield-Scale).

Diagnosis.—Hemispherical, somewhat larger than *hemisphaericum*, marked by one longitudinal and two transverse ridges, which form together a raised letter H. Colour black, varying to brown, the latter state being var. *testudo*, Curtis. It is to be remarked that the ridges, so conspicuous in this species, are to be observed in the young of *hemisphaericum*; but they do not remain in the adult, as in *oleæ*.

Distribution.—Common enough in Kingston, Jamaica; found by Mr. Barber in Antigua, and by Mr. Ulrich in Trinidad. Also in Europe, California, Florida, S. Carolina, New Zealand, Australia and Hawaii.

Food-plants.—Recorded from many different plants; olive, camellia, *Cassinia leptophylla*, orange, guava, *Ficus Carica*, oleander, holly, live oak, peas, apricot, plum, pomegranate, Oregon ash, bittersweet, apple, *Eucalyptus*, Sabal palm, California coffee, rose, Cape jessamine, *Habenaria elegans*, *Brachæton*, heath, *Brexia*, *Crataeva*, *Soushumber*, *Terminalia*, almond, *Acer dasycarpum*, *Artemisia californica*, *Abutilon*, &c.

It was Mr. Maskell who recorded it on *Cassinia leptophylla*, and since that time he has separated the specimens found on this plant as a distinct species, *Lecanium cassina*. It is from New Zealand.

Destructiveness.—Well-known, especially in California, as a very injurious scale. In the West Indies it does not appear to do so much harm as *L. hemisphaericum*, nor is it, at least in Jamaica, a serious pest of the orange or olive. At Moneague, Jamaica, I searched the bitter orange trees, and found only one example of the scale. Although common in Kingston, an olive tree in the yard of the Jamaica Institute was not attacked by it.

Enemies.—It is known to be attacked by a fungus in Australia; in California a species of *Capnodium* doubtfully referred to *C. citri*, was found on dead scales, and it was surmised that it might attack living ones.

The larva of a moth, *Erastria scitula*, Rambur, preys on it in Europe; while in Australia it is similarly attacked by the larva of *Thalpochares coccophaga*, Meyrick.

A beetle, *Rhizobius ventralis*, Er., was found useful as an enemy of the Black Scale in California; this beetle is a native of Australia, whence it had been introduced to feed on scale-insects.

A Chalcidid parasite, *Tomocera californica*. Howard, destroys it in California at Orange, Cal., in 1889, it was observed that 80 per cent.

of the scales were destroyed by this parasite. The name of the genus, *Tomocera*, has been altered by Mr. Howard to *Dilophogaster*, but I think without necessity.

The following table may facilitate the identification of the West Indian Shield-Scales :—

- (A.) Without distinct ridges in the adult.
- (a.) Very flat, dark brown, tessellated ... *L. tessellatum*.
 - (b.) Very flat, greenish or pale brownish,
more or less triangular ... *L. mangiferae*.
 - (c.) Slightly or moderately convex, rather soft, never dark
brown or black.
 - i. oval, brownish or yellowish ... *L. hesperidum*.
 - ii. oval, very small, brownish-crimson ... *L. rubellum*.
 - iii. broader than oval ... *L. terminaliae*.
 - iv. longer than oval ... *L. longulum*.
 - (d.) Moderately convex, not soft, shiny, brown or black.
 - i. elongate or oval forms ... *L. depressum*.
L. assimile, var.
 - ii. shorter, broader forms ... *L. begoniae*.
L. urichi.
 - (e.) Very convex, hemispherical, brown ... *L. hemisphaericum*.
L. ficum.
- (B.) With distinct ridges forming an H. ... *L. oleæ*.

(To be continued.)

Las Cruces, New Mexico, U.S.A.

April 19, 1894.

EXPORT OF POTATOES, ONIONS AND TOMATOES.

The following letter has been received by the Governor from Messrs. Gillespie Bros. & Co. in answer to inquiry made on the subject.

No. 4 Stone Street, New York,

April 17th, 1894.

Your Excellency :—We think a good trade could be made in the exportation of potatoes, onions and tomatoes, because we think your market could place these articles here earlier than Bermuda does

In the depth of the winter, however, the consumption is limited, and we think 100 barrels every two weeks of potatoes, and from 300 to 500 crates of 1 bushel each of onions, and 500 crates of tomatoes, would be ample.

We would quote for a large sized potato (and by the way, we would recommend that they be assorted and properly marked) \$7.50 to \$10.00, and, in extreme cases, as high as \$15.00 being paid per barrel. Mediums fetch from \$5.50 to \$6.00 Onions are worth from \$2.25 to \$2.50 per bushel, while tomatoes are worth, packed in small crates and then in carriers, from \$4.50 to \$6.00 per carrier, which contains six baskets of about three quarts each.

We are making arrangements to send you an empty carrier and the baskets, and will, on a subsequent occasion, take pleasure in sending you the price of these packages. We think there is also a good market for:

an earlier asparagus, which would be cultivated on your higher altitudes and brought to great perfection. With faster steamers we think that strawberries could also be brought here to advantage.

We remain, Sir,
Yours faithfully,

GILLESPIE BROS & Co.

To His Excellency Sir Henry A. Blake,
Governor of Jamaica, &c.

AN ORCHID FROM CAYMAN ISLANDS.

SCHOMBURGKIA THOMSONIANA, Reichenb. f.

In Veitch's *Manual of Orchidaceous Plants, Part II*, published in the latter part of 1887, the following notice of this plant occurs:—

"Flowers only seen by us. Pseudo-bulbs, leaves, and inflorescence as in *S. tibeticus*, but smaller. Sepals and petals linear-oblong, $1\frac{1}{2}$ inches long, the petals a little narrower than the sepals, cream-white at the base, passing to buff-yellow at the apex, the sepals simply undulate, the petals crisped. Lip three-lobed, the side lobes triangular, rolled over the column, white on the exposed side; the middle lobe oblong, emarginate, much crisped, deep maroon-purple, disc yellow, traversed by five raised lines which extend to the base of the lip, and of which the two outside ones are the broadest, in the central area between the side lobes, these raised lines are deep purple, and from which on either side are numerous oblique purple streaks. Column triquetral, bent, bidentate at apex, pale green.

"*Schomburgkia Thomsoniana*, Rehb. in Gard. Chron. II. s. 3. (1887) p. 38.

"A species new to science and to horticulture that has recently flowered in the collection of Mr. W. J. Thomson, at St Helen's Lancashire. Nothing is recorded of its origin."

The habitat was not known until May, 1888, when I brought it from the Cayman Islands. My specimens were named at Kew, and a note inserted in the *Kew Bulletin* for July, 1888, p. 162.

Dr. Strachan visited these Islands in 1892, and noted two varieties, of which only one grew in Cayman Brac. He has been good enough to contribute the following paragraphs:—

"*S. Thomsoniana*, var. *albo-purpurea*. Flower larger, colour cream or white and purple, lip with throat deep purple and tip but little recurved.

S. Thomsoniana, var. *minor*. Flower smaller, colour canary-yellow and purple, lip without much purple in throat, and tip extremely recurved.

"Var. *minor* was the only one I collected in Cayman Brac, but in Grand Cayman I found both varieties, and var. *albo-purpurea* was in greater abundance than *minor*. In habit and general structure the varieties show no marked difference.

HENRY STRACHAN, F.L.S."

Mr. Rolfe writes from Kew Gardens that the specimens sent by me to Kew from Grand Cayman and Cayman Brac are "practically uni-

form in size,—evidently 'var. minor.' Reichenback's original is distinctly larger, segments $\frac{1}{4}$ inch longer. This may represent 'var. alboburpurea.'

W. F.

ALFALFA GROWING IN AUSTRALIA.

In the dry districts of the colony, where alfalfa growing has been attempted on a pretty extensive scale, the experiment has invariably proved an unqualified success. The majority of the failures have no doubt been caused by treating the plant badly during the first year of its existence. No stock should be put on alfalfa the first year after sowing, and it is better to allow two seasons' growth then cut, if possible. By that time the plants should be thoroughly established, and are hard to kill out. In feeding crowd the stock on, and eat off as quickly as possible, then shift as soon as ever the paddock is bare. The alfalfa patch should be divided into three convenient-sized enclosures, and each grazed in rotation. It is keeping the stock too long on a certain piece that does the harm to alfalfa. As soon as the plant is fed down it has a tendency to throw up shoots for next crop. Look at the crown of a matured plant, and it will be noticed that the new growth starts principally from the circumference of the woody apex in delicate white shoots, and also from the remains of old flower-stems. This means that as soon as the old growth is fed off the new growth starts, and, if the continuous feeding is going on, they get trodden and nipped off, and, being very tender and immature, bleeding takes place, causing much damage to the crop. One serious injury will throw that field back all through the season. This is the most important point in alfalfa-growing, and the greatest reason that it has not been a success in many instances. Nine out of ten paddocks are killed or ruined the first two years, the first principally.—*Australasian*.

FERNS: SYNOPTICAL LIST.—XXVII.

Synoptical List, with descriptions of the Ferns and Fern-Allies of Jamaica, by G. S. Jenman, Superintendent Botanical Gardens, Demerara, (continued from Bulletin 3 and 4).

36. *Asplenium rhizophorum*, Linn.—Stipites caespitose, from a short dark scaly upright rootstock, 4-6 in. l. channelled, polished dark-brown; rachis similar, slender, terminating in a filiform naked whip-like radiant tail several inches long; fronds simply pinnate, lanceolate-oblong, firm, naked, dark-green, $\frac{1}{2}$ - $\frac{3}{4}$ ft. l. $2\frac{1}{2}$ - $3\frac{1}{2}$ in. w. base truncate, abruptly terminating at the top; pinnæ nearly horizontal, 12-18 to a side, the lowest hardly at all reduced, the upper slightly or much so, the final one usually distant, inferior base cut away, the opposite side expanded and sometimes auricled, truncate, blunt or acute at the point, $1-1\frac{1}{2}$ in. l. $\frac{1}{4}$ - $\frac{1}{2}$ in. w., laxly serrulate, the teeth evanescent in the outer part; veins simple or forked; sori oblique, $1\frac{1}{2}$ - $2\frac{1}{2}$ li. l. confined to the outer two-thirds of the pinna, equally short of both midrib and margin.—Hook. Sp. Fil. vol. 3. t. 187. fig. A. *A. cirrhatum*, Rich. *A. Karstenianum*, Klotzsch.

Var. A.—Fronds $\frac{1}{2}$ -1 ft. l.; lower pinnæ auricled, or with a single

40. *A. grandifolium*, Swartz.—Rootstock stout, scaly, erect; stipites caespitose, strong erect, 1-1½ ft. l. dark fibrillose at the base; rachis similar; fronds pinnate, erect, 1-2½ ft. l. ¾-1 ft. w. truncate and not reduced at the base, dark green, paler beneath and brownish, firm pellucid, naked; pinnæ nearly horizontal, opposite or alternate, 4-6 in. l. 1½-1¾ in. w., distant or sub-distant, less often approximate, sessile or the lower petiolate, acuminate, the base equal-sided, rounded, or the upper subcordate and gradually becoming fully adnate passing into the lobate-entire acuminate apex: margins entire, sinuate or sinuate-lobate, sometimes serrate towards the point; veins at a wide angle, 2-4 times forked, in fascicles of 4-6 each; sori copious, occupying all but the central veinlets, the inferior outer ones double and ½-¾ in. l; involucre broad, dark brown at maturity.—*Diplazium*, Sw. *Hemionitis*, Sm.

Very common in moist woods on the banks of rivers among the lower hills, and ascending to 1,500 ft. alt. A fine and very beautiful plant, the underside picturesque with the copious sori and dark, brown, glossy involucre on the background of pale green surface.

41. *A. celtidifolium*, Mett.—Rootstock stout, erect, reaching 1½ ft. high, paleaceous at the summit, stipites caespitose, 1-1½ ft. l., scaly beneath, specially at the base, light green, the rachis similar, fronds pinnate, 1½-3½ ft. l., ¾-1½ ft. w., light green, pellucid and rather thin, slightly fibrillose on the ribs beneath, upper side naked, reduced little or much at the base; pinnæ numerous, mostly horizontal, close or nearly so, 6-10 in. l., 1-2 in. br., acuminate or acute, quite sessile and subcordate, often auricled on the lower base overlapping the rachis, upper ones passing gradually through pinnatifid to lobed into the serrulate acuminate apex of the fronds; margins repand or sinuate lobate; veins close, pinnato-fasciculate the branches of each group running subparallel towards the margin; sori thin or very copious on all the lower branches, reaching half to three-fourths from midrib to margin, all or nearly all double; involucre pale, narrow,—*Diplazium*, Kze. *A. centripetale*, Baker.

Common in moist forests from 2500-6000 ft alt. Usually the sori are only on the inferior veinlets, and reach only half-way from the midrib to the margin, but in the largest states the shorter outer branches are also fertile, and, in consequence of the proximity of the nearly parallel veins, the surface is covered almost to the edge. The scales become fibrillose as they ascend from the base of the stipites. It was first gathered by James Harlow, who took plants home, two hundred years ago. The widely spread *A. sylvaticum*, Presl. found lately in Cuba by Eggers has somewhat narrower firmly coriaceous, bright glossy pinnæ, auricled on both sides at the base, the lower distant and much reduced. *A. Godmani*, Baker, recently discovered in St Vincent and Grenada resembles the larger states, but has fronds and pinnæ twice as large, with more open venation, the veinlets, more especially the outer ones, more or less anastomosing.

CONTRIBUTIONS TO THE DEPARTMENT.

LIBRARY.

Hooker's *Icones Plantarum*, Vol. II., Pt. IV. April, 1894. [Bentham Trustees through Kew.]

- Bulletin Royal Gardens, Kew. No. 88. April, 1894. [Kew.]
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 Household Remedies, by Thos. Christy, F.L.S. [Author.]
 Cronbie (Jas. M.) A Monograph of Lichens found in Britain. London, 1894
 8. vo. [Trustees British Museum.]

SEEDS.

From Botanic Garden, Saharanpur.—2 lots.

Abies Smithiana. *Abies Webbiana.* *Pinus excelsa.*

From Messrs. Reasoner, Bros., Florida.

Abrus precatorius. *Agave recurvata.* *Borreria arborescens.* *Caesalpinia pulcherrima.* *Clerodendron siphonanthus.* *Hedychium coronarium.* *Ilex glabra.* *Ilex opaca.* *Ipomoea Polyanthus.* *Lettsonia sp.* *Moringa pterygosperma.* *Myrica cerifera.* *Nelumbium luteum.* *Ptelia trifoliata.* *Rhus copallina.* *Schinus terebinthifolius.*

From Dr. F. Franceschi, Santa Barbara, Cal.

Aristolochia elegans. *Cupressus macrocarpa.* *Delphinium cardinale.* *Dolichus cultratus.* *Doryanthes Palmeri.* *Erythea armata.* *Erythea edulis.* *Fourcroya Longeva.* *Ficus aurea.* *Heteromeles arbutifolia.* *Ipomoea rubro-coerulea.* *Ipomoea Roxburghi.* *Ipomoea splendens.* *Mandevillea suaveolens.* *Nelumbium nuciferum roseum.* *Nymphaea Dentata.* *Nymphaea lotus.* *Rhus integrifolia.* *Sagittaria montevidensis.* *Washingtonia filifera.* *Yucca baccata.* *Yucca Whipplei.* *Zamia Integrifolia.* *Thalia dealbata.*

From H. Caracciolo, Trinidad.

Pritchardia pacifica.

From Revd. H. H. Isaacs, Halfway Tree.

Mahoe and *Naseberry.*

From Mr. R. K. Tomlinson, Lacovia.

Bactris sp.

From H. P. Deans, Priestman's River.

Sapindus saponaria.

From Mr J. C. Harvey, California.

Washingtonia filifera. *Heteromeles arbutifolia.* *Erythea armata.* *Erythea edulis.*

From Botanic Gardens, Durban.

Agapanthus umbellatus. *Albuca sp.* *Anemone Fanniniæ.* *Anomatheca cruenta.*

Aristea Eckloni, Ceratotheca triloba, Chironia purpurascens, Clematis Stanleyi, Dierama pendula, Encephalartos villosus, Encephalartos caffra, Erythrina caffra, Gladiolus Eckloni, Kniphofia Woodii, Littonia modesta, Mimosa obovata, Ophiocaulon gummifera, Sandersonia aurantiaca, Streitzia augusta, Thalictrum rhynchocarpum, Tephrosia macropoda, Tephrosia grandiflora, Vernonia yernonella, Vitis capensis.

From Botanic Gardens, Bangalore.

Ipomæa grandiflora.

From Botanic Gardens, Demerara.

Carapa guianensis.

JAMAICA.

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REPORT ON GINGER CROPS.

5th April, 1894.

SIR,

In my Annual Report for 1892-93 attention was called to the difference in prices realised for ginger in different parishes.

His Excellency the Governor requested me to make further enquiries, especially in some of the districts where ginger is grown, and I have the honour now to submit the following statement :

The quality of commercial ginger upon which the price depends, is due chiefly to soil, but also to curing, to the variety, white or blue and to whether it has been freshly planted a few months before or has been "ratooning" for one or more years.

The soil, which produces the very highest quality realising perhaps £10 per cwt. in the London market is the very deep black soil of the virgin forest. To grow ginger under this condition involves the destruction of large areas of forest.

Magnificent trees, six feet in diameter, may be seen in some districts lying rotting on the ground, while the ginger cultivators have gone further to the centre of the Island, abandoning the woodlands already cut down. The plan adopted in cleaning the forest is, for a cultivator to invite 10 or 12 of his friends to a "cutting match", he provides food and drink and the laborious work of felling trees is carried on merrily and without much expense. Afterwards fire is put, and the place is burnt over. This burning is considered very important, as much so as the virgin soil. Probably its importance is due principally to the deposit of potash and other mineral matters contained in the ashes, but the fire will also sweeten the ground correcting sourness and moreover it destroys insect pests. Some cultivators will only grow ginger in freshly cleared woodland and next year they move on to a new clearing, but although in this way they get very fine ginger it is at the expense

of forest land which would require a very heavy outlay and perhaps a term of a hundred years to restore. Albert Town was not so long ago a centre for the cultivation but I was told there that growers had already got as far as fourteen miles further inland.

Ginger can be and is grown in many places year after year on the same ground. An intelligent cultivator at Borobridge stated that he knew of ginger growing for forty years in the same patch.

Seaford Town is a German colony and one of the original colonists, Somers, an active old man of 86 years of age, has been cultivating ginger and arrowroot there since his youth; he and the other colonists have been in the habit of planting a small patch one year leaving it to ratoon as long as it was profitable, then throwing it up or growing other plants until after a term of years they again plant the same patch with ginger. This is an irregular rotation of crops "Plant ginger" the produce of planting is of better quality than the ratoons and the ratoons in each succeeding year are inferior. When the ground is too poor to grow "white ginger" then "blue ginger" the inferior variety can be grown.

More depends upon the curing of ginger, considering the crop as a livelihood than soil. At Seaford Town there was a wet season about two years ago, the people could not dry the ginger in the sun, it mildewed, there was consequently very little sale, and the cultivators suffered some distress. I believe from what I saw that as a rule careful attention is given to the curing, and that the badly cured ginger brought sometimes to market is due to wet weather rather than to want of care.

It is difficult to make any recommendations on the subject but the following hints may indicate what points are worthy of consideration by the cultivators. The first is the application of manure. There is a prejudice against its use, some maintaining that it breeds worms, and that there also is a difficulty in getting it in any quantity. It is probable that those who have not succeeded with manure, have used it improperly by applying it fresh or not sufficiently mixed with soil. As to obtaining it in quantity, example should be taken from the Chinese labourer who preserves every particle of matter that can in any way be utilised as manure, not only cattle manure, but decaying matter of any kind, night-soil, etc., even soapy water left after washing is most useful. To imitate the formation of forest soil, a pit might be filled with alternate layers of bush and manure, everything in the nature of manure or decaying matter should be thrown in, and a layer of soil directly over the manure would be useful. The pit ought to be lined with clay to prevent the very valuable part of the liquid of the manure from escaping, and a cover of some kind, e. g. a sheet of corrugated iron, should be fixed in some way over the pit to keep out rains. I noticed several head of cattle in the Seaford Town district, and apparently the manure is lost, because the cattle wander about in search of food. Possibly grass or clover might be grown in old ginger grounds, and the cattle tethered so as to confine them in one place and the manure easily collected.

To facilitate curing and even sometimes to save the crop, the chief storekeeper in a district, who buys the ginger might find it advantageous to himself and the people to invest in an American Evaporator and dry the ginger artificially.

Possibly the Government could take steps through the Surveyor-General to prevent the forests from being ruthlessly destroyed.

The export of ginger is on the whole on the increase as seen from the following table, but if this is accompanied by the gradual destruction of woods and forests it is not a subject for congratulation.

Yr.	Cwt.	Value.
1887	9,927	£17,789
1888	10,222	19,463
1889	8,952	18,615
1890 ($\frac{1}{2}$ yr.	4,948	11,133
1891	10,885	24,493
1892	16,272	40,681
1893	13,632	27,264
1894	14,932	44,796

W. FAWCETT.

THE INFLUENCE OF EUCALYPTUS PLANTATIONS ON MALARIAL DISTRICTS.

FROM "PALUDISM" BY PROF. DR. A. LAVERAN.

Paludism has disappeared almost completely from a great number of localities formerly very unhealthy. Examples of this happy transformation abound, not only in Europe, but also in countries where endemic paludism is very severe—for example, in Algeria.

Among the most efficacious measures of salubrity may be quoted the drying of the morass, drainage, and cultivation of the soil.

The drying the soil by draining it, by mechanical methods, or by cultivation obviously modifies the media in which the parasites of paludism are developed, and the soil is rendered less susceptible to the multiplication of these agencies.

The drying of a marsh ought only to be made with method and with great precautions, above all in a hot country, the season in which the palustral epidemic does not prevail, or exists only with least intensity, should be chosen and care should be taken not to uncover a great surface of the marsh during the hot season, the marsh is, indeed, much more dangerous when it begins to dry than when it is covered with water. The example of Lancisi, causing the ditches of Fort Saint Ange to be filled to assuage the ravages of paludism is well known, in Holland the same means have been employed more than once with success.

During the drying of the marsh the workmen should not pass the night in its midst, and they should be submitted to the preventative treatment with quining during the fever season.

Regular cultivation at all times makes the soil healthy, but certain trees and shrubs are particularly good for this purpose.

The plantations of eucalyptus which have been made during the last twenty years in a great number of palustral countries have already rendered great service, notably in Corsica, in Algeria, and in Italy.

From 1861, Ramel has considered eucalyptus to be capable of combating paludism, the credit belongs to him of having imported the *Eucalyptus Globulus* into our country.

Torelli has mentioned the following fact, which is a good example of the great influence exercised by plantations of eucalyptus:—Near Rome

outside the gate of Ostia, in a place called the Three Fountains, there is a convent which in 1868 had been abandoned for a long time on account of its insalubrity, and which bore the significant name of Tomba. Pope Pius IX gave this convent to the Trappist monks who took possession of it, but in these deplorable circumstances. For the first few years it was so unhealthy that the monks could not sleep there, being obliged to spend the night in Rome, not returning to the Three Fountains till after sunrise.

The first plantations of eucalyptus were made in 1869. In 1876 the improvement was such that the Trappists could stay the night in the convent without being attacked by fever. In 1877 the number of trees exceeded 2,500. A space of 988 acres was then allotted to the Trappists with the condition that they should plant 100,000 trees in ten years. In 1879 the plantation suffered much from frost, but during the following years the Trappists planted 25,000 trees each year, and at the end of 1881 there were already 55,000 eucalyptus trees at Three Fountains, and palustral fevers were becoming rarer.

The salubrity of the farm of Three Fountains has been disputed by Tommasi Crudeli, but his assertions are contradicted by Torelli and Baccelli and by the monks who live in the convent of Three Fountains, and who are well able to judge in the matter. (Bull. de la Soc. Nationale d'Acclimation, Jan., 1885).*

Michon has given two very interesting and convincing examples of palustral localities being made healthy by the planting of eucalyptus. (Bull. de la Soc. Nat. d'Acclimation, Jan., 1885). A great property situated on the east coast of Corsica, near to Algeria and to the penitentiary of Casabianca, was uninhabitable on account of fever, even the warden himself refused to remain there during the summer. The owner had planted before the guard-house a small plantation of from 200 to 300 eucalyptus, and from 400 to 500 along a river. These plantations have flourished, and now the warden is able to live there with his family summer as well as winter. The workmen who come down from the mountain to work in the vineyards on this same property, which was formerly so unhealthy, do not contract the fever.

On the east coast of Corsica there is a small place of the name of Solenzara, in which steel-works were established. When the works were begun to be set up all the population were in the habit of emigrating for four months, from July to October, which shows clearly how fearful the palustral endemic was. One of the owners caused sixty acres to be planted with eucalyptus, since then the fever has disappeared from Solenzara. All the population are prosperous, and no one now thinks of emigrating during the summer.

In certain localities extremely favourable to the development of paludism the plantations have not succeeded in completely dispelling the fever.

Riviere, who has disputed the febrifuge properties of the eucalyptus plantations, giving as his argument the persistence of the fever at Ain Mokra and at the mines at Mokta (on Lake Fetzara in the province of Constantine), has himself furnished the explanation of their non-success which is after all relative, because the plantations of eucalyptus have even at Mokra produced an improvement in the sanitary condition.

* I have personally ascertained on the spot from the monks the beneficial effects of the Eucalyptus plantation. (Editor.)

"We have planted the banks of the Fetzara," writes Riviere, "but the plantation was required to be kept at a certain distance from the maximum limit of water, which increases suddenly owing to the torrential overflowing of the Oued-Zid and El-Aout into the immense basin. The waters cover more than 34,580 acres, and are displaced by certain winds, but the natural escape and the loss produced by rapid evaporation cause immense miasmatic surfaces to be laid bare, thus producing, through an absolutely direct isolation and rise of temperature, morbid elements against which the recent plantations on its banks are quite futile. (Bull. de la Soc. Nat. d'Acclimation, January, 1885). Riviere considers that in these conditions it would be advantageous to plant bamboos first, in order to circumscribe and to reduce by degrees the central basin. The example of Ain Mokra cannot be quoted against the eucalyptus, it is evident that it could not be expected to make the region completely salubrious by planting eucalyptus upon the banks of such an immense marshy surface as Riviere speaks of.

The *Eucalyptus Globulus* is the best known of the eucalypti, it is that which was first introduced into Europe, and is chiefly used in the old plantations: in the new plantations the *E. Globulus* has been replaced by the *E. rostrata*, mainly in Algeria. The *E. Globulus* does not resist cold or great heat, it requires good ground, neither dry nor too wet, and perishes rapidly in too marshy soil. The *E. rostrata* is more hardy. (Riviere, op. cit.)

Does the eucalyptus act simply as other vegetation by draining and drying the soil? If the soil is rendered more rapidly salubrious by it than other trees, is it only because its growth is more rapid, or must it be admitted that it has special virtues, and that it enjoys the property of destroying the parasites of paludism? This latter hypothesis is in itself not unlikely. The eucalyptus, in fact, gives out aromatic vapours which possess antiseptic properties, besides the leaves and branches which cover the soil contain a large proportion of eucalyptol, which may prevent the development of the germs of paludism.

The influence of sulphur mines upon paludism has been pointed out by d'Abbadie. It appears, from the facts quoted by him, that the sulphurous emanations which are produced in the neighbourhood of sulphur mines have a favourable effect in palustral countries. (Commun, a l'Academie des Sciences, September 18th, 1882). This action of sulphurous acid is easy to understand, unfortunately it does not seem that it can be used to render localities healthy.

In speaking of the individual prophylaxis I have already said that in palustral countries it is necessary to watch carefully the drinking-water, which seems to serve as the vehicle of the germs of paludism, to the general rules for making a locality healthy, the necessity for providing that locality with water of good quality must, therefore, be added.

FERNS: SYNOPTICAL LIST.—XXVIII.

Synoptical List, with descriptions of the Ferns and Fern-Allies of Jamaica, by G. S. Jenman, Superintendent Botanical Gardens, Demerara, (continued from Bulletin 5).

42. *Asplenium Shepherdii*, Spreng.—Root-stock, stout, erect, oblique, paleaceous on the crown, stipites caespitose, $\frac{3}{4}$ –1 ft. l. strong channelled, the base dark and deciduously scaly, fronds pinnate or pinnate-pinna-

tifid, ovate or deltoid-acuminate, 1-2 ft. l. $\frac{3}{4}$ -1 $\frac{1}{2}$ ft. w. naked, dark green, pellucid, thinly chartaceous, the base not reduced, the apex pinnatifid and passing gradually into the serrate or serrulate point; pinnæ nearly horizontal, inferior subdistant, petiolate, upper adnate and shortly decurrent, the lowest usually as large as any, the largest $\frac{1}{2}$ - $\frac{3}{4}$ ft. l. 1-1 $\frac{3}{4}$ in. w. cut on both sides one-third or halfway to the midrib into broad rounded subcrenulate lobes $\frac{1}{2}$ in. br. the interior one on the superior side of the base usually much (or little) larger than the rest (and, rarely, in the lowest pair of pinnæ quite free) the interior ones on the lower side of the midrib reduced, the basal one smallest with its inner margin oblique with the strong, channelled wood-brown rachis, veins pinnate in the lobes, single and forked, sori linear, curved, 2-5 li. l. often confined to the lowest exterior veinlet, or occupying as well several above, only the first however being double; involucre narrow, thin. *A. ambiguum*. Raddi, Fil. Bras. t. 54, 54 bis.

Frequent in damp woods and forests from among the lower hills up to 4,000 or 5,000 ft. alt. a much larger plant as a rule than any of the *arborescens* group, marked by the broader pinnæ, nearly uniformly lobed to about the same depth throughout, those of the upper part adnate-decurrent, and of the lower petiolate. The majority of local specimens are fertile only on the exterior veinlet, but occasionally nearly all are fertile. Sprengel's name is generally employed, but Raddi's has priority.

43. *A. costale*, Swartz.—Rootstock very stout, erect or oblique, attaining a foot or more high, the crown clothed with dark lanceolate scales; stipites caespitose, erect, stout, channelled. 1-2 ft. l. base paleaceous; fronds bipinnatifid, 2-4 ft. l. 1 $\frac{1}{2}$ -2 ft. w., not or little reduced at the base, the apex pinnatifid, gradually passing into the serrate acuminate point, subcoriaceous, generally dark green, paler beneath, pellucid-dotted, the parenchyma naked, pinnæ horizontal, oblong-lanceolate acuminate, the lowest petiolate $\frac{3}{4}$ -1 $\frac{1}{2}$ ft. l. 2 $\frac{1}{2}$ -5 in. w. pinnatifid to within a $\frac{1}{4}$ - $\frac{1}{2}$ in. of the costa, the apex subentire and serrated lobes $\frac{1}{2}$ - $\frac{3}{4}$ in. br. close, subfalcate, the interior one on the superior side usually a little reduced, acute, spinulose-serrate in the outer part, the teeth within appressed and faint, rachis and costæ slightly deciduously scaly; veins pinnate, the branches spreading, forked; sori oblique; linear, 3-5 li. l. extending from the midrib $\frac{1}{3}$ - $\frac{1}{2}$ way to the margin, usually confined to the lower half of the lobe, only the inferior, if any, double, involucre very narrow.—*D. apollinaris*, Fee Fil. Ant. t. 10. f. 1.—Segments deeply and sharply toothed throughout.—*A. Desrauxii*, Mett.

Frequent in most forests from 2,000-6,000 ft. alt. This has no near local ally, and is marked by its very robust size, subarborescent, caudex, and simply pinnatifid pinnæ, the latter giving it a very leafy appearance.

44. *A. striatum*, Linn.—Rootstock stout, erect, eventually several inches high, clothed with dark, blackish, lanceolate paler on the crown; stipites erect, strong, 1 $\frac{1}{2}$ -2 ft. l. channelled, paleaceous at the dark base; rachis similar; fronds erect, bipinnatifid, oblong-lanceolate, base not reduced, the acuminate apex pinnatifid, 1 $\frac{1}{2}$ -2 ft. l. $\frac{3}{4}$ -1 $\frac{1}{2}$ ft. w. thinly chartaceous, variable in colour, naked on the ribs puberulous pinnæ numerous, oblong-lanceolate, horizontal, deeply pinnatifid, $\frac{1}{2}$ - $\frac{3}{4}$ ft. l. 1 $\frac{1}{4}$ -1 $\frac{3}{4}$ in. w. sessile or very shortly stipitate at the truncate base, the

point serrate-acuminate; segments $\frac{1}{2}$ – $\frac{3}{4}$ in. l. from the sharp sinus, 3–4 li. b. oblong, rounded, horizontal, close, crenato-serrate; veins pinnate, branches simple or once forked, the lowest opposite pair excurrent above the sinus, sori copious, extending $\frac{2}{3}$ up the segment, generally only the lowest double; involucre narrow.—Plum. Fil. t. 18 and 19. *Diplazium*, Liebm. *A. crenulatum*, Baker.

a. Var. *grammatoides*, Fée.—Stipites and fronds taller, stronger, pinnæ more distant, and fully pinnate at the base (only the base), with an open space between the segments, which are crenulate-serrate or slightly lobate at the base.—*Diplazium grammatoides*, Fée Fil. Ant. t. 11.

b. Var. *bipinnatisectum*, Gr.—Fronds ample, $1\frac{1}{2}$ – $1\frac{3}{4}$ ft. w., pinnæ $\frac{3}{4}$ –1 ft. l. 3–4 in. w. those of the lower half or more of the frond fully pinnate their greater length; pinnulæ $1\frac{1}{2}$ – $1\frac{3}{4}$ in. l. $\frac{1}{2}$ – $\frac{3}{4}$ in. w. the point acute, entire, within cut into shallow lobes in which the veins are pinnate with curved simple branches.—Gr. Fl. B. W. I I. p. 686.

c. Var. *expansum*, Pinnæ $\frac{3}{4}$ –1 ft. l. $2\frac{1}{2}$ –4 in. w., pinnulæ with their own width more or less between them, $1\frac{1}{2}$ –2 in. l. $\frac{1}{3}$ – $\frac{1}{2}$ in. w. tapering from the base outwards, very shallowly cut within into broadly rounded lobes; veins impressed on the upper rather glossy surface; sori very copious, quite covering the surface.—*A. expansum*, Willd.

d. Var. *tripinnatifidum*, Jenm.—Fronds ample, pinnæ 1 ft. l. 4 in. w. oblique (not horizontal), pinnulæ 2– $2\frac{1}{2}$ in. l. $\frac{1}{2}$ – $\frac{3}{4}$ in. w. base truncate, lower not quite sessile, cut $\frac{1}{3}$ – $\frac{2}{3}$ toward the midrib into close, straight, oblong lobes, which are subangular forming rather a point at the anterior corner.

Frequent in moist woods and forests from the vallies of the lower hills up to 3,000 ft. alt. or higher. The type, which is uniformly strictly bipinnatifid only, the segments being nowhere entirely separated, is common in the Eastern parishes at the lower elevations; so also is the first variety, a stronger, taller plant, which is fully bipinnate, the complete separation of the segments being confined however to the base of the lower pinnæ only, the upper not showing it; in the next variety, which is again larger, the lower pinnæ are fully pinnate from half to two-thirds their length, and the larger pinnules are slightly lobate; in the other varieties, c and d, which are found at the higher elevations, the fronds are still larger, and uniformly tripinnatifid in the lower half or two-thirds. These varieties can hardly be distinguished from the smaller states of *radicans*, except by the upper third or fourth of the frond, which in the type and all the varieties alike is indistinguishable, being quite different to the same portion of the fronds of that species. The species was founded by Linnæus on Plumier's figures quoted above, which represent the type, and are unmistakable, though somewhat artificially drawn.

45. *A. Klotzschii*, Mett.—Rootstock stout, erect, the crown clothed with lanceolate brown scales, stipites caespitose, erect, $\frac{3}{4}$ – $1\frac{1}{2}$ ft. l. channelled, brown, puberulous, the dark base clothed with deciduous palea; rachis similar; fronds bipinnate, oblong-lanceolate, not reduced at the base, the pinnatifid serrate apex acuminate, $1\frac{1}{2}$ –3 ft. l. $\frac{3}{4}$ –1 ft. w. herbaceous-chartaceous, dark clear green and nearly naked above, paler beneath and glandulose-pubescent, the vestiture rusty at maturity, pinnæ horizontal, lax throughout, the lower distant, stipitate or petiolate, the upper more or less apart and sessile, pinnate in the inner half or third,

thence pinnatifid, the end serrato-acuminate, pinnulæ horizontal, apart or subdistant, oblong, $\frac{1}{2}$ – $\frac{3}{4}$ in. l. $\frac{1}{4}$ – $\frac{3}{8}$ in. w. the interior ones of the lower pinnæ reduced, and the lowest one on the inferior side of the one to two lowest pairs of all absent, free and rounded at the base, becoming gradually adnate and closer as the pinnatifid outer part is approached, rounded at the end, throughout crenato-dentate, the teeth 1–2 li. w.; veins pinnate, the branches open; sori short, few or many double, reaching halfway to the margin from the midrib; involucre brown, delicately membranous, plain or tumid, eroded.—*Lotzea diplazioides*, Klotz et Karst. *A. Hartianum*, Jenm.

Var. *mazima*, Jenm.—All parts much larger vestiture and colour similar.

Infrequent in forests of the middle and higher, though not highest, mountain regions. A plant of very lax habit throughout, furnished beneath, and slightly so above at first, with a rusty glandulose pubescence and having short sori and plain or tumid eroded or fimbriated involucre. It is No. 1,745 and 1,753 of Linden's Cuban collections, and was gathered in Columbia by Karsten and Moricand and in Venezuela by Fendler. In cutting it comes nearest some of the less compound forms of *striatum* from which it differs by its very lax habit, vestiture and involucre. The variety may be distinct.

46. *Asplenium radicans*, Schk.—Rootstock very stout, erect, reaching $\frac{1}{2}$ –1½ ft. high, clothed with dark scales at the top; stipes caespitose, erect, stout, channelled, dark deciduously paleaceous at the base; rachis similar, fronds ample, tripinnatifid, 3–4½ ft. l. 1½–3 ft. w. chartaceous, dark green, paler beneath, naked above, puberulous beneath; pinnæ spreading, subdistant, inferior petiolate, lowest pair usually not or little, reduced, if not largest, 1–1½ ft. l. $\frac{1}{2}$ – $\frac{3}{4}$ ft. w. or over, pinnulæ approximate the inferior usually more or less stipitate, those above sessile, upper adnate, oblong or ovate-lanceolate, base truncate, apex serrulate-acuminate 3–6 in. l. $\frac{3}{4}$ –1½ in. w. cut shallowly or deeply into close oblong blunt or rounded even or crenate segments which are $\frac{1}{3}$ – $\frac{1}{2}$ in. l. 2–4 li. w., veins pinnate simple, or the basal anterior, forked, sori copious, variable 1–2 or 3 li. l. short of the margins; involucre flat or slightly raised, membranous, brownish.

a. Var. *pallidum*, Jenm. Fronds much smaller; pinnæ less acuminate, shallowly and broadly lobed, colour light pale green on both sides, sori and involucre also pale, rachis rather slender.

b. Var. *crenatum*, Jenm.—Fronds average size of the type, ultimate segments crenulate-dentate, the strongest tooth situated at the base, almost in the sinus; under surface rather more ciliate.

c. Var. *remotum*, Jenm.—Fronds very large, pinnæ 1½–2 ft. l. $\frac{3}{4}$ –1 ft. w.; pinnulæ 5–6 in. l. 1½ in. b. stipitate deeply pinnatifid; segments $\frac{3}{4}$ –1 in. l. 3–4 li. w. broadly rounded; veins forked; costules and ribs pubescent beneath.

Frequent in moist regions in forests and shady places, chiefly near streams, from 2,000–4,000 ft. alt; very variable in size and other features. As intimated under that species, the line is not a very clear one in dealing with herbarium specimens between the more compound states of *striatum* and this, *a* was gathered at Second breakfast Spring between Mt. Moses and Tweedside, St. Andrew, *b* in a gully in the Cinchona Plantation on the road to Morce's gap, and *c* on the banks of the upper sources of the

Clyde river, a few hundred feet below the same Plantation. The forms however are widely dispersed in the region mentioned. It is impossible to study this species and its allies except in a wild state; and for the same reason it is useless to attempt to disentangle its frightfully confused synonymy.

47. *A. duale*, Jenm.—Rootstock woody, oblique or decumbent, clothed with dark scales, stipites tufted, strong, stiff, dark, channelled, naked or with a few small scales at the base. rachis similar; fronds oblong-lanceolate, pinnate, firm and stiff, dark glossy green, paler beneath, glabrous, $\frac{1}{2}$ –1 $\frac{1}{4}$ ft. l. 2 $\frac{1}{2}$ –5 in. w. the base truncate, gradually reduced at the top to the lobate-serrate acuminate apex; pinnæ spreading obliquely, oblong lanceolate, acuminate, $1\frac{1}{2}$ –3 in. l. $\frac{1}{2}$ –1 in. b. the base cut away shortly on the inferior side, the upper side expanded and often auricled, petiolate, the lower freely so, the margins conspicuously lobate-serrate, and incised; veins once or twice forked, curved, the inferior fascicled or again pinnatifid; sori linear, $\frac{1}{4}$ – $\frac{3}{4}$ in. l. forming a single or double series on each side, diverging from the midvein at a narrow angle, single or double; involucre narrow, firm, even.

Locally frequent in the central parishes at the mean and higher elevations; gathered in St Ann and Clarendon. The larger fronds only have the sori diplazioid, and this character with the sharp and uniformly grouped teeth of the margins, readily characterise it from *A. falcatum* which, of local species it most resembles, and its other near allies—*A. macrophyllum*, Swartz, *A. Gardneri*, Baker and *A. caudatum*, Forst. of the Eastern and Southern hemispheres.

48. *A. arboreum*, Willd.—Rootstock small, short, upright, the crown scaly; stipites caespitose, a span to a ft. l. channelled, brown, deciduously paleaceous at the base; fronds pinnate, lanceolate or oblong-lanceolate, usually slightly narrower at the base, the apex lobed at the serrate-acuminate point, $\frac{1}{2}$ –1 $\frac{1}{2}$ ft. l. 3–6 in. w. firmly chartaceous, pellucid-dotted, light rather glossy green; pinnæ numerous, nearly horizontal, $1\frac{1}{2}$ –3 $\frac{1}{2}$ in. l. $\frac{1}{2}$ – $\frac{3}{4}$ in. w. close or sub-distant, lower stipitate, cut away briefly on the inferior base, the opposite side expanded, auricled or with a partly free ovate segment, beyond this subentire, serrate or slightly lobate-serrate to the entire acuminate point; veins forked (pinnate in the auricle) pellucid; sori linear, oblique, rather curved, 2–5 li. l. on the lowest exterior branch, mostly uniserial, but often occurring on the outer branches too, few or several double; involucre pale, membranous.—*A. auriculatum*, Mett. (non Swartz).

a. Var. *unifolium*.—Pinnæ entire, but crenate-serrate, only the one or two lowest pairs auricled.

b. Var. *pinnatifidum*.—Pinnæ uniformly lobed one third deep throughout both sides, the basal lobe free only in the lowest pair or two.

c. Var. *pinnatum*.—Pinnæ of the lower half, quarter, or less of the frond with a distinct, quite free, ovate, cuneate pinnule on the superior base.

d. Var. *obtusum*.—Fronds a span or over l.; pinnæ $1\frac{1}{2}$ in. l. or over, the upper entire, next below auricled or lobed, the lower pairs with a single or opposite pair of free pinnules at the base.—*A. semihastatum*, var. *obtusum*, Mett.

Common in forests and on shady banks from 3,500–6000 or 7000 ft. alt.; a well marked but highly variable species, the variation being more

miscellaneous than definite as to fixed permanent forms. Though in the least cut forms the sori are uniserial, in the larger states there is a second incomplete row; and the more uniformly lobed pinnæ, with the venation pinnate in the lobes, are sometimes copiously fertile. As a rule only the interior sori are double. The name is a misnomer,, having been given by Willdenow under the idea that the rootstock was *arboreus*.—Sloane first gathered it.

49. *A. semihastatum*, Kunze.—Rootstock small, fibrous, erect or obliquely decumbent, clothed with small dark scales; stipites cæspitose, slender, 4–10 in. l. light green, slightly scaly at the base; rachis similar, winged in the upper part; fronds bipinnate, lanceolate or oblong-lanceolate, 6–10 in. l. $1\frac{1}{2}$ –3 in. w. chartaceous, glossy, naked, broadest usually at the base, apex lobate-serrate acuminate; pinnæ spreading, distant, relatively few, 1–2 in. l. $\frac{1}{2}$ – $\frac{3}{4}$ in. w. those of the lower half or two-thirds stipitate, with a few oval segments on one or both sides at the base, lobed beyond this to the outer entire blunt point, veins forked, pinnate in the lobes, branches much curved, sori copious, the longer 2–3 li. l. and often double, involucre narrow, dark or light brown.—*A. cubense*, Hook, Sp. Fil. vol. 3 t. 207. *A. hymenodes*, Mett.

Infrequent on rocky shaded banks from 1,500–2,000 ft. alt. or higher, gathered in St. Mary and Portland, closely resembling some of the forms of *arboreum*, but smaller, more slender, much more lax, with fewer, distant pinnæ, which in the lower half or more of the frond are uniformly pinnate and broad at the base.

50. *A. monticolum*, Jenm.—Stipites tufted $\frac{1}{2}$ –1 ft. l. slender, channelled, arising from a small fibrous brown-scaly rootstock; fronds bipinnate, $\frac{1}{2}$ –1 ft. l. 3–5 in. w. oblong or ovate-lanceolate, chartaceous, pellucid-dotted, pale, glossy, naked, not narrowed at the base, the acuminate apex lobed and serrate; pinnæ numerous, spreading at a wide angle, $1\frac{1}{2}$ –2½ in. l. $\frac{1}{2}$ –1 in. b. the inferior subdistant, stipitate, fully pinnate at the base, the under side shortly cut away, the upper deep, beyond that pinnatifid or lobed to the sharply serrated or biserrated, blunt or acute point; segments ovate; rachis slender, brown, naked, veins pinnate in the segments and lobes, branches simple or inferior forked; sori curved 1–3 li. l. occupying most of the veins; the inferior double, involucre narrow.—Journ. Bot. 882 p. 326.

Infrequent on the sides of banks and rocks 4,000–5,000 ft. alt.; near *semihastatum*, from which it may be recognised by its larger size, more numerous approximate pinnæ which are more pinnatifid and sharply serrate. There is a casual superficial resemblance to *Fadyeni* and *Franconis*, but the former has laxer pinnæ more pinnatifid in the outer part, and the latter is large and compound. In mature fronds the abundant sori nearly conceal the involucre.

51. *A. Fadyeni*, Hook.—Rootstock shortly repent, as thick as stout cord; stipites 4–10 in. l. slender, subtufted, with a few small deciduous dark brown reticulated scales at the base, fronds bi- or tripinnate, 5–9 in. l. 2½–5 in. w. ovate-lanceolate, the base not narrowed, gradually tapering to the serrate-acuminate apex, dark green, chartaceous, naked, rachis channelled, light green, slender, flat and margined in the upper part and slightly flexuose; pinnæ apart, subdistant, petiolate, opposite or alternate, $1\frac{1}{2}$ –2½ in. l. $\frac{3}{4}$ –1½ in. w. pinnate or bipinnate, broadest at the base and thence tapering to the serrate-acuminate point segments

$\frac{1}{2}$ – $\frac{3}{4}$ in. l. 2–4 li. w., subdistant or distant, ovate or lanceolate, acute-blunt pointed or rounded, cuneate-stipitate, sharply dentate, veins pinnate, simple or forked, sori copious, 1–2 li. l. occupying most of the veins, inferior double; involucre dark brownish.—Hook, 2nd Cent., Ferns. t. 27. *A. diminutum*, Baker. Jenm. in Journ. Bot. 1881, p. 53.

Infrequent, gathered in St. George, Portland, on the sides of wet, dripping, calcareous rocks. At about 2,000 ft. alt, in shade. Marked by the lax arrangement of pinnæ and pinnulæ. the latter and final segments all being sharply toothed or inciso-dentate. Only the largest fronds are tripinnate and only at the base. The specimens first discovered, and figured by Hooker were very small.

52. *A. Franconis*, Mett.—Rootstock short, erect, clothed with large, blackish lanceolate scales; stipites cæspitose, $1\frac{1}{2}$ –2 ft. l. strong, the base black and paleaceous, stramineous upwards and naked: rachis similar, flexuose, fronds tripinnate, ovate-acuminate, 2–3 ft. l. $1\frac{1}{2}$ –2 ft. w. not reduced at the base, chartaceous, naked, pellucid, light green and glossy paler beneath, pinnæ spreading petiolate, $\frac{1}{2}$ – $1\frac{1}{4}$ ft. l. 3–5 in. w. pinnulæ lanceolate, stipitate, deeper on the superior side, shortly cut away on the under, 2–3 in. l. $\frac{3}{4}$ –1 in. w. serrate-acuminate, cut within into ovate or oblong blunt or rounded dentate free segments which are $\frac{1}{2}$ – $\frac{3}{4}$ li. l. and $1\frac{1}{2}$ –3 li. w. veins pinnate in the segments, simple or forked, sori copious, oblique, $1\frac{1}{2}$ –2 li. l. bright brown, occupying most of the veins, the inferior double; involucre silvery.—Gr. Fl. B. W. I. p. 657.

Frequent in moist woods from the lower valleys up to 2,500 ft. alt. The barren state, in which it is often found, much resembles *Davallia inequalis*, and is difficult to distinguish. The pinnæ and pinnulæ are rather distant, the tertiary segments close and compact. The underside of fertile fronds have a very beautiful aureous tinge from the blended colours of the surface, involucre and sori. The Jamaica form is more compound than the continental.

53. *A. conchatum*, Moore.—Rootstock short, erect, clothed at the top with large lanceolate or ovate lanceolate dark scales: stipites cæspitose erect, $1\frac{1}{2}$ – $2\frac{1}{2}$ ft. l. paleaceous at the dark base, glabrescent, channelled, light or dark brown, rachis similar; fronds erect, bipinnatifid, hardly narrowed at the base, acuminate, $2\frac{1}{2}$ –4 ft. l. 1 – $1\frac{3}{4}$ ft. w. chartaceous, pellucid, dark green, glabrescent, pinnæ numerous, spreading obliquely or horizontally, oblong-lanceolate, acuminate, 6–10 in. l. $1\frac{1}{4}$ –2 in. w. close or more or less distant, shortly petiolate, pinnatifid to the narrow wing of the costa, apex serrate-acuminate; segments linear-oblong, $\frac{3}{4}$ –1 in. l. 2–3 li. w. horizontal, blunt or rounded, rarely acute, more or less serrated, close or apart, the sinuses sharp or open, rounded; veins simple or forked: pellucid; sori $\frac{1}{2}$ – $\frac{3}{4}$ li. l. close to the midrib, the interior double; involucre firm, persistent, dark, vaulted.—*Hypochlamys pectinata*, Fée.

a. Var. *Tussacii*.—Segments $\frac{1}{2}$ in. l. 1–2 li. w. round pointed, even or faintly serrulate, sinus open, rounded, sori $\frac{1}{2}$ li. l. *Hypochlamys Tussacii*, Fée Fil. Ant. t. 9 fig. 1.

b. Var. *squamulosum*.—Pinnæ almost or quite pinnate at the base, segments with a wide open sinus between, deeply lobate-dentate.—*Hypochlamys squamulosum*, Fée Fil. Ant. t. 9 fig. 2.

Common near streams in forests and shady places from 1,500–4,000 ft. alt. The sori are very variable in the different forms, usually short, but in some cases reaching nearly to the margin, the involucre being

very firm, persistent and dark coloured. This and *Polypodium caudatum*, Klf. are quite identical in cutting. The shorter sori and vaulted involucre mark it from any of the least cut forms of *striatum*.

54. *A. hians*, Kunze.—Rootstock stout, erect, reaching eventually 2 ft. high, always in masses; stipites cæspitose, erect, 2–3½ ft. l. channelled, the base clothed with large ovate-lanceolate, blackish scales, puberulous upwards; rachis similar; fronds 3–4½ ft. l. 1½–2½ ft. w. little if at all reduced at the base, the apex fully pinnate almost to the acuminate point, chartaceous, pellucid, dark green, paler beneath, glabrescent or the costules puberulous-scaly beneath; pinnæ spreading or erect-spreading, oblong-lanceolate acuminate, approximate, 1–1½ ft. l. 3–6 in. w. sessile or petiolate, pinnulæ 1½–3 in. l. ¼–¾ in. w. numerous, sessile, approximate or subdistant, the acuminate point serrulate, cut two-thirds to three fourths to the costulæ into rounded straight or subfalcate segments which are 4–5 li. l. 1½–2 li. w. even or faintly crenulate, veins pinnate, simple, pellucid, sori ½–1 li. l. the lowest anterior double; involucre convex, pale.—*Diplazium*, Kze.

Common in shady places, nearly always gregarious near streams from 2,500–5,000 ft. alt. Generally the pinnæ are turned upwards by a short curve at the base, due to the crowded conditions of growth, the plants pressing densely on each other; where one is found alone they spread at a wide angle. It has nearly exactly the same range of cutting as *striatum*, and the larger forms of the two species can only be distinguished one from the other by the shorter sori and tumid involucre of this. These also are the only distinguishing features from some of the forms of *radicans*.

55. *A. altissimum*, Jenm.—Rootstock stout, erect or decumbent, beset with the projecting bases of past stipites, paleaceous at the crown; stipites cæspitose, few, 2–3 ft. l. strong, dark, scaly and densely muricate at the base; fronds ovate, acuminate, tripinatifid, 2½–4½ ft. l. 1½–2½ ft. w. not, or little reduced at the base, chartaceous, dark green, paler beneath and lurid; pinnæ, lower subopposite, 1–1½ ft. l. 5–8 in. w. the base petiolate, the apex pinnatifid, serrate acuminate at the point; pinnulæ near or subdistant, substipitate, oblong-lanceolate, 3–4 in. l. 1–1½ in. w. deeply pinnatifid, serrate-acuminate, the inferior usually reduced; segments close, oblong, ½–¾ in. l. 2–4 li, w. rounded, crenulate or deeply toothed or lobed; rachises and costæ dark, channelled, the latter rather flexuose; veins pinnate, simple or forked; sori close to the midrib ¾–1 li. l. the inferior often double; involucre firm, convex, pale brown.—*Journal Bot.* 1886 p. 259.

Frequent in depressions and ravines of the forests of the ridges and slopes from 6,000–7,000 ft. alt. In very moist situations the upper pinnæ are gemiparous in the axils. The lowest pair of pinnæ are petioled to an inch or more long, and are deeper on the lower side. The short tumid involucre distinguish it at once from *radicans*, and the much broader parts from *hians*, in which the involucre are similar.—*A. Taylorianum*, Jenm. *Journ. Bot.* 1886. p. 269, marked by sessile pinnæ uniformly and conspicuously obtusely toothed margins, and very small sori, that are nearly punctiform, both pinnæ and pinnulæ being viviparous in the upper half of the frond, is probably a variety of this.

A. Filix-femina, Bernh. the Lady fern of Britain and Europe which

is widely spread in both the Eastern and Western Hemispheres has been found in Cuba. It has an erect caudex, cæspitose paleaceous, stipes, oblong-lanceolate, bipinnate or tripinnatifid fronds, the base usually narrowed, pinnæ 3-8 in l. $\frac{3}{4}$ -1 $\frac{1}{2}$ in. w. and toothed or pinnatifid pinnulæ $\frac{1}{2}$ - $\frac{3}{4}$ in. l. and subreniform or oblong curved involucres. It should be looked for at high elevation in Jamaica.)

56. *A. bruneo-viride*, Jenm.—Rootstock stout, erect, crown dotted with dark scales; stipites cæspitose, strong, erect, brown 2-3 $\frac{1}{2}$ ft. l. paleaceous at the base; fronds 3-4 ft. l. 2-3 ft. w. tripinnate or quadripinnatifid, chartaceous, pellucid, naked except the costæ and costulæ which are fibrillose, light or dark brown-green; pinnæ oblong lanceolate, 1 $\frac{1}{4}$ -1 $\frac{3}{4}$ ft. l. $\frac{1}{2}$ - $\frac{3}{4}$ ft. w. shortly petiolate, the lower deeper on the inferior side pinnulæ numerous, contiguous not sessile, 3 $\frac{1}{2}$ -5 in. l. 1 $\frac{1}{4}$ -1 $\frac{1}{2}$ in. w. the point serrate acuminate; tertiary segments oblong rounded, firm and nearly sessile, contiguous, $\frac{3}{4}$ -1 in l. 2 $\frac{1}{2}$ -4 or 5 li. w., lobed or deeply pinnatifid, the lobes oblong, rounded, 1 $\frac{1}{2}$ -2 $\frac{1}{2}$ li. l., about half as w. and narrow sinuses; rachis wood-brown, channelled; costæ and costulæ margined with green membrane; veins pinnate, simple 2-3 to a side; sori copious $\frac{1}{4}$ - $\frac{1}{2}$ li. l. the lowest anterior double; involucres tumid, pale brown. Journ. Bot. 1886. p. 269.

Infrequent in moist forests at 5,000-6,000 ft. alt. Resembling the next species in outline and cutting, but larger in all its parts, and of a lighter colour. Both are near *A. Sandurichianum*, Mett. Gathered by Morris and Sherring on the slopes beyond the Govt. Cinchona Plantation. With careless drying it turns black.

57. *A. Wilsoni*, Baker.—Rootstock stout, erect or decumbent, clothed with large blackish palea on the crown; stipites cæspitose, subangular below and paleaceous, upwards channelled, dark puberulous, 1-2 ft. l. fronds tri or quadripinnate, 1 $\frac{1}{2}$ -3 $\frac{1}{2}$ ft. l. 1-2 $\frac{1}{4}$ ft. w. little or not reduced at the base, the apex fully pinnate to the serrate narrow point, membranous-herbaceous, pellucid, dull dark green, naked; rachis costæ and costulæ narrowly winged with lucent membrane, and scurfy-puberulous; pinnæ nearly horizontal, the lower deflexed, numerous $\frac{1}{2}$ -1 $\frac{1}{4}$ ft. l. 3-5 in. w. oblong lanceolate, nearly sessile, pinnate to the serrate point; pinnulæ very numerous, contiguous, often somewhat overlapping, 1 $\frac{1}{2}$ -3 in. l. $\frac{1}{2}$ -1 $\frac{1}{4}$ in. w. the inferior usually a little reduced; tertiary segments oblong, blunt, dentate, pinnatifid or the inferior fully pinnatifid at the base, contiguous blunt, $\frac{1}{4}$ - $\frac{3}{4}$ in. l. 2-4 li. w., final lobes in the largest states 1-2 li each way, veins simple or forked in the ultimate teeth or lobes, sori $\frac{1}{2}$ - $\frac{3}{4}$ li. l. copious, involucres tumid, brown, inferior double. - Syn. Fil. p. 242.

Frequent in dells and ravines of the moist forests of the ridges from 6,000-7,000 ft. alt. Like *altissimum* in similar situations it is sometimes viviparous in the axils of both pinnæ and pinnulæ. Small fronds are tripinnate, but the larger are often fully quadripinnate. The narrow channel of the rachis and costæ is almost concealed by the inflexed membrane of the margins. The final cutting is much finer than in *bruneo-viride*.

58. *A. marginatum*, Linn.—Rootstock very stout, erect, scaly, stipites cæspitose, erect, stout, 2-3 ft. l. base paleaceous; fronds erect, 4-6 ft. l. 2 $\frac{1}{2}$ -3 $\frac{1}{2}$ ft. w. simply pinnate, membranous or firmer, pellucid, glabrous,

bright green, pinnæ numerous, opposite, spreading, distant, 1-1½ ft. l. 3-4 in. w. with a distinct terminal one like the lateral, sessile and cordate overlapping the strong rachis, apex acuminate or cuspidate, repand, scarioso and crenulate-edged, vein running in close, parallel lines from the costæ two-thirds to the margin, and there freely anastomosing and forming a network of elongated areolæ, with an exterior transverse intra-marginal vein; sori linear, on the simple portions of the veins; involucres narrow, membranous—Plum Fil. 106. Hook; Fil. Exot. t. 63.

Infrequent in moist districts near streams in woods and well shaded places among the valleys of the lower mountains at from 1,000-2,000 ft. alt. A majestic plant, the largest of the *Asplenium*, and hardly inferior in its stately proportions to *Hemitelia horrida*.—Plumier first gathered it.

CONTRIBUTIONS TO THE DEPARTMENT.

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SEEDS.

From Royal Gardens, Kew—

Seeds of Plants from Lagos:—

Aloe, sp.

Andrographis paniculata

- Athrotaxis cupressoides.
 Codonocarpus australis.
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 Echinocactus Wislizeni.
 Ficus sp.
 Frenela intratropica.
 Gardenia Rothmannia.
 Kigelia sp.
 Myrsine Urvillei.
 Pelargonium tetragonum.
 Philydrum lanuginosum.
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 Podocarpus elongata.
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 E. platyphylla.
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 Diospyros Lotus.
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Dalbergia frondosa.
Hiptage Madablotta.
Hibiscus collinus.
Myrospermum toluifera.
Nyctanthus arbor-tristis.
Peltophorum ferrugineum.
Pterospermum suberifolium.
Sclerocarya Caffra.
Sterculia alata.

From Prof. Max. Cornu. Paris—

Corypha umbraculifera.

From W. G. Clark, Gordon Town—

Passiflora maliformis.

From Insp. Clark, Morant Bay—

Passiflora maliformis.

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.]

JULY, 1894.

Vol. I.

Part 7.

REPORT ON THE COCKPIT COUNTRY.

SIR,

I was directed by His Excellency the Governor to inspect and report on the country round Ipswich, considering it as a sample of the Cockpit country, with reference to its capabilities for cultivation; and have now the honour to submit the following remarks for His Excellency's consideration.

I am unable to say whether the country along the railway for some distance on both sides of Ipswich station, is a fair representation of what the whole of the Cockpit country is like, but I imagine that at any rate a very good idea can be obtained of the conditions necessary before this part of the island can be utilised to any extent.

The following statement of areas in the three parishes of Trelawny, St. James, and St. Elizabeth, of Crown lands and lands liable to forfeiture to the Crown, refers to this special formation known as '*Cockpit*,' and shows that there must be cogent reasons which have hitherto prevented these lands from being utilised:—

	Crown Lands.	Forfeitable Lands.
	acres.	acres.
Trelawny	24,800	31,000
St. James	2,100	10,000
St. Elizabeth	1,200 (about)	10,000 (about)
Total	28,100 (about)	51,000 (about)

Grand total of unutilised lands in the Cockpit country about 79,100 acres.

The origin of the word '*Cockpit*' is said to be due to the peculiar appearance of immense hollows of the shape of an inverted cone. This is not very evident near Ipswich, the hollows being rather trough-like, very deep and the sides almost or quite precipitous. I was taken to the top of a hill to see Bunder Hole, a huge hollow, several acres in extent, with precipitous sides of limestone rock, the depth of which has been estimated at over 400 feet. Such a spot as this appears to be quite useless, even if the soil at the bottom is of the richest description, for there is no means of entrance. The surface of the country is covered

with large blocks of limestone, and it is to this character of ruggedness, as well as to the steepness of the sides of the hills and valleys that the inaccessibility of the country is due.

Some of the valleys if once rendered accessible would probably be found to be exceedingly rich in their soil. Ipswich valley is one of the most charming spots in Jamaica. The Y. S. river which runs through it has deposited a great depth of finely divided rich alluvial soil, forming a level plain of some extent, surrounded by picturesque hills covered with large trees. I was told that when this plain was cultivated for sugar, the Bourbon cane ratooned, to the knowledge of my informant, 13 years in succession. It is now only used for pasture, but as there is a good driving road through it, and the railway on the hill just above, such a valley ought to prove a mine of wealth to the owner if cultivated in bananas, cocoa, and nutmegs. There are possibly many more valleys of the same general character in the Cockpit country.

The soil varies here and there, sometimes a hollow contains too much clay, but wherever a river has made such a deposit as in the Ipswich valley, it will in all probability be found to be a mixture of some clay from the weathering of the limestone, mixed with material derived from the disintegration of trappean and granitic rocks, all in a very fine state of division, thus forming a most fertile soil.

A sandy deposit which had been used to some extent on the railway in making concrete, is evidently a disintegrated granitic rock, the grains of which are not water-worn.

The "brugadoo," which in some parts of the island is very soft, is here quite hard, the materials, of trappean origin, being apparently cemented together by a deposit of iron.

Although, judging even by the appearance and the character of the natural vegetation, the soil in the Cockpit country is very fertile, and would well repay cultivation, the difficulties to be encountered in crossing the country have been an absolute bar to its being taken up. Without roads produce cannot be brought to the market, and the fertile soil is worth nothing. With roads, leading to such valleys as Ipswich, this part of the island would prove to be one of the richest. But on the other hand the expense of making roads would be so great, that if undertaken at all, they could only be made by the Government.

It remains to point out what cultures might be undertaken in the vicinity of the railway, and any roads which may at present exist, or may be formed in the future.

Wherever bananas can easily be taken to the roads or railway, they could be grown to advantage. Cocoa and nutmegs might be cultivated at all the lower elevations, and Liberian Coffee also by planters who could plant sufficient to keep a pulper and other machinery at work. Common or Arabian Coffee would do well at the higher elevations. Of rubber plants, the Central American rubber tree (*Castilloa elastica*) should grow well almost everywhere, if planted amongst other trees, and the native rubber plant, or "milk withe" (*Forsteronia floribunda*) should be encouraged and planted chiefly in the higher elevations.

I have, &c.,

W. FAWCETT.

The Hon. The Colonial Secretary,
Kingston.

NOTES ON PLANTS YIELDING RUBBER. I.

PARA RUBBER (*Hevea brasiliensis*, Muell, Arg.)

Source.—Para rubber obtains the highest price in the market. It is yielded by trees, which are chiefly *Hevea brasiliensis*, and *H. Spruceana*.

The trees are usually 60 feet in height when tapped, and they should be at least 18 inches in circumference

H. brasiliensis has trifoliate leaves, the leaflets being lanceolate.

Locality.—These rubber trees grow in the forests on the Amazon and its tributaries, and the provinces of Para and the Amazons have hitherto been the chief source of the rubber supply. But as the trees are being quickly destroyed by injudicious methods of tapping, collectors have now to go beyond Para, and have penetrated even to Bolivia.

Soil.—The soil in which the trees grow is deep and rich, mainly alluvial, sometimes a stiff clay, sometimes a vegetable mould; and it is frequently inundated along the banks of the rivers. A large extent of low country on the banks of the Amazon is under water during the wet season.

Temperature.—The temperature is very equable throughout the year, ranging from 73° F. to 95°, though not generally above 87°, the mean for the year being 81°. This condition of temperature is an important one; as is proved by the failure to grow these trees in Northern India, where the nights of the winter months are cold, while the experiment in Ceylon and South Burma is said to be a success.

Rainfall.—The rainy season lasts from January or February to June or July, the highest monthly rainfall of 15 inches being in April. The rest of the year is called the dry season, when little rain falls, though there is scarcely a week without some showers. It is at this time that the rubber is collected. But in other districts it rains more or less all the year round, and in these places collecting rubber is difficult and not profitable. For, if the stem of the tree is wet, the milk spreads over the bark instead of running into the cups; moreover, rain falling into the milk will prevent it from properly coagulating. The atmosphere is excessively damp.

Best Districts in Jamaica.—The Para rubber trees will probably only succeed in Jamaica in districts with an annual rainfall over 75 inches, at elevations not at any rate greater than 2,000 feet. It is impossible to state without experiments what the upward limits may be. The districts in which experiments may well be made are parts of Portland, St. Thomas in the East, St. Mary's, St. Ann's, Hanover, Westmoreland, St. James's, St. Elizabeth, Manchester and Clarendon. A dry season for collecting appears to be desirable, and possibly in this respect the west end of the island possesses greater advantages than the east-end.

Collection of Rubber.—Mr Robert Cross, who was employed by the Government of India to obtain seeds and plants of rubber trees in America, gives, in his Report to Government, the following account of the method employed in Para to collect the rubber:—

"The collectors begin to work immediately at daybreak; or as soon as they can see to move about among the trees. They say the milk flows more freely and in greater quantity at early morn. I do not attach much importance to this statement, but I have recorded it. Another and more probable reason is, that as rain often falls about two or three

o'clock in the afternoon the tapping must be done early, as in the event of a shower the milk would be spattered about and lost. The collector, first of all, at the beginning of the dry season, goes round and lays down at the base of each tree a certain number of small cups of burnt clay. At the lesser trees only three or four are put, but at the larger ones from eight to twelve are deposited. The footpaths leading from tree to tree are likewise cleared of sapling growths, and the bridges over the *gapos* (natural ditches) formed at each place by the trunk of a tree are, where necessary, replaced. On proceeding to his work the collector takes with him a small axe for tapping and a wicker basket containing a good-sized ball of well-wrought clay. He usually has likewise a bag for the waste droppings of rubber, and for what may adhere to the bottoms of the cups. These promiscuous gatherings are termed *ser-namby*, and form the 'negrohead' of the English market. The cups, as already stated, are of burnt clay, and are sometimes round but more frequently flat or slightly concave on one side, so as to stick easily when with a small portion of clay they are pressed against the trunk of the tree. The contents of fifteen cups make one English imperial pint. Arriving at a tree, the collector takes the axe in his right hand, and, striking in an upward direction as high as he can reach, makes a deep upward sloping cut across the trunk which always goes through the bark and penetrates an inch or more into the wood.* The cut is an inch in breadth. Frequently a small portion of the bark breaks off from the upper side, and occasionally a thin splinter of wood is also raised. Quickly stooping down he takes a cup, and pasting on a small quantity of clay on the flat side, presses it to the trunk close beneath the cut. By this time the milk, which is of dazzling whiteness, is beginning to exude, so that if requisite he so smooths the clay that it may trickle directly into the cup. At a distance of four or five inches, at the same height another cup is luted on, and so the process is continued until a row of cups encircle the tree at a height of about six feet from the ground. Tree after tree is treated in like manner, until the tapping required for the day is finished. This work should be concluded by nine or ten o'clock in the morning, because the milk continues to exude slowly from the cuts for three hours or perhaps longer. I may state that there is a great difference among collectors in the performance of these duties. Some take care to get good clay previously and incorporate it well, so that a very small portion is needed to lute the cups to the trunks, they also work with great neatness and intelligence, and invariably collect a good quantity of milk. Others, again, do not take the trouble to prepare clay beforehand, but merely scrape up a handful when they require it at the side of a *gapo*, which is often of little consistence, so that a large quantity is required to fasten the cups. This class of collectors have often many fragments of clay or other impurities in their milk, the result of not following a proper method of working. The quantity of milk that flows from each cut varies, but if the tree is large and has not been much tapped, the majority of the cups will be more than half full, and occasionally a few may be filled to the brim.

* Collins says:—A long perpendicular incision is made from near the base and extending high up the trunk. On each side of this line and meeting it are numerous small oblique cuts. Sometimes a basal cut is made extending some distance round the trunk on each side of the vertical cut."

But if the tree is much gnarled from tapping, whether it grows in the rich sludge of the gapo or dry land, many of the cups will be found to contain only about a tablespoonful of milk, and sometimes hardly that. On the following morning the operation is performed in the same way, only that the cuts or gashes beneath which the cups are placed are made from six to eight inches lower down the trunks than those of the previous day. Thus each day brings the cups gradually lower until the ground is reached. The collector then begins as high as he can reach, and descends as before, taking care however, to make his cuts in separate places from those previously made. If the yield of milk from a tree is great, two rows of cups are put on at once, the one as high as can be reached, and the other at the surface or the ground, and in the course of working, the upper row descending daily six or seven inches, while the lower ones ascend the same distance, both rows in a few days come together. When the produce of milk diminishes in long-wrought trees, two or three cups are put on various parts of the trunk where the bark is thickest. Although many of the trees of this class are large, the quantity of milk obtained is surprisingly little. This state of things is not the result of overtapping, as some have stated. Indeed I do not believe it is possible to overtap a tree if in the operation the wood is not left bare or injured. But at every stroke the collector's axe enters the wood and the energies of the tree are required in forming new layers to cover these numerous wounds. The best milk-yielding tree I examined had the marks of twelve rows of cups which had already been put on this season. The rows were only six inches apart, and in each row there were six cups, so that the total number of wood cuts within the space of three months amounted to seventy-two. It grew close to a gapo only eight inches above high-tide mark, and being a vigorous tree the cups were usually filled, but with two years or so of such treatment the tree would probably be permanently injured. It has been supposed that the quality of the milk is better in the dry season than during the rains. Such is the case with some vegetable products, but as regards India-rubber there ought not, I think, to be any appreciable difference. In the rainy season the milk probably contains a greater portion of water, but on the other hand, I am of opinion that then a larger quantity of milk flows from the tree. No doubt the dry season is the most suitable for caoutchouc collecting, although wherever a plantation is formed with preparing-house convenient, tapping may certainly be carried on when the weather is fine."

"Collection of the Milk.—Going from tree to tree at a sort of running pace, the collector empties the contents of the cups into a large calabash, which he carries in his hand. As he pours the milk out of each cup he draws his thumb or fore-finger over the bottom to clean out some which otherwise would adhere. Indeed, a small quantity does remain, which is afterwards pulled off and classed as *sernamby*. The cups on being emptied are laid in a little heap at the base of each tree, to be ready for the following morning. The trees occur at various distances from 10 to 100 yards apart, and as I travelled over the intricate network of muddy footpaths, I continually felt perplexed and surprised that the natives have not yet seen the advantages that would be derived by forming plantations, whereby more than twice the quantity of

caoutchouc might be collected in one-fourth the time, and at far less cost of labour."

The fresh milk exhales an odour of ammonia, and if it has to be carried to any distance 3 per cent. of liquid ammonia is added to keep it unchanged, but it is much better to coagulate the rubber on the day of collection, and so prevent any danger of decomposition which results in impurity of the rubber, and consequently a low price in the market.

Yield.—Each tree is said to give 2 ounces of milk in a day, and the milk yields from 30 to 50 per cent. of rubber.

Dr. Trimen states in his Report of the Royal Botanic Gardens for 1893:—"Though I have expressed the opinion that this is a cultivation more suited to a Government Department than to private planters, yet if the cultivator can afford to wait for about twelve years, there is little doubt of a profitable return. After the trees are once in full bearing they are said in Brazil to continue to yield for a period of 75-100 years."

The growth of a tree in the Henaratgoda Garden in Ceylon, a wet district, has been at the following rate, the measurement being taken at 3 feet from the ground:—

Age in years.	Circumference.	
	feet	inches.
4	1	4
5	1	9
6	2	1½
7	2	6
8	3	0
9	3	7
10	4	1
11	4	5½
12	5	0
13	5	5
16	6	1
17	6	7½

In the Jamaica Gardens the growth has been exceedingly slow, but in other localities in the island, doubtless the increase would be as great as in Ceylon.

Methods of preparing the Rubber.—Mr. Cross gives the following details of the preparations of the Para rubber:—

"The collectors of the region I visited, resorted with their milk to a large shed situated on the bank of the river Guama. Here were various species of palm nuts, representing *Attalea excelsa* and *Euterpe edulis*, stored in heaps, and several jars for the preparation of rubber. These jars were 18 inches high and the bottoms were broken out. At the base they were 7 inches in diameter, bulging out in the middle to 12 inches, and were narrowed at the mouth to a breadth of 2 inches. Each person wrought on his own account, and so small jars were employed, but where a number of men are collecting for one master much larger jars are in use. The milk, on being put into a large flat earthen vessel, is put down on the floor in a convenient place. Adjacent thereto the jar is set on three small stones, which raises it to 1½ inches above the floor. The narrow space between the base of the jar and the floor allows the air to enter, which causes a current of smoke to ascend with remarkable regularity and force. When the fire commences to burn

strongly, several handfuls of nuts are put on, then some more wood and nuts alternately. These are dropped in at the mouth of the jar until it is filled to within four inches of the top. Due care is taken that a sufficient proportion of wood is put in with the nuts. The mould on which the rubber is prepared resembles the paddle of a canoe, in fact, at many places on the Amazon this is the article most frequently used if there is much milk, and when the rubber is prepared in bulky masses. Occasionally the mould is slung to the roof, as the weight in handling it during the process would otherwise be very fatiguing. A little soft clay is rubbed over it to prevent the rubber from adhering, and it is afterwards well warmed in the smoke. The operator holds the mould in one hand, while with the other he takes a small cup and pours two or three cups of milk over it. He turns it on edge for a few moments above the dish until the drops fall, then quickly places the flat side two inches above the jar mouth, and moves it swiftly round as if describing the form of a cipher, with his hand, so that the current of smoke may be equally distributed. The opposite side of the mould is treated in the same way. The coatings of milk on the mould on being held over the smoke immediately assume a yellowish tinge, and although it appears to be firm on being touched, it is found to be soft and juicy, like newly curdled cheese, and sweating water profusely. When layer after layer has been repeated, and the mass is of sufficient thickness, it is laid down on a board to solidify, and in the morning cut open along the edge on one side and the mould taken out. Biscuit rubber when fresh, is often four or five inches thick. On being hung up to dry for a few days, it is sent to market. When I saw the process of smoking the rubber performed, as just described, I was considering the statements of Keller, and other travellers who write on this subject, all of whom seem to believe that the smoke from the palm nuts possesses some peculiar or strange property by which means the milk instantly coagulates. But on one occasion, when the collector was commencing to smoke some milk, I saw him wait for a short time, during which he put his hand repeatedly to the mouth of the jar, and soon learned that he could do nothing until the smoke was hot. The dense white smoke rose abundantly, but the milk would not thicken on the mould. After a little while the jar became heated and the operation went on quite satisfactorily. I put my hand to the mouth of the jar, but could bear the heat scarcely a second, and although the temperature of the smoke was apparently less than boiling water, yet I judge it must have been at least 180° Fahrenheit. Therefore the rapid coagulation of the milk is simply produced by the high temperature of the smoke. I have no doubt that with a strong current of heated air, or a good pressure of steam from a pipe, a similar result would be obtained. The finely divided particles of soot which forms a portion of the smoke undoubtedly absorb a considerable amount of moisture although at the same time it must be looked on as an impurity. I have no hesitation in giving my opinion that equally as good rubber could be prepared by putting the milk in shallow vessels, and evaporating the watery particles by the heat of boiling water."

Another account is, that, "Small cups are attached to the trees, and, when filled with juice, are emptied into tin pails of a certain size, having close fitting lids, the cups being again attached to the trees. After going the round of the trees, the contents of this pail are emptied

into another a size larger, and so on, till the covered pail of largest size is filled and ready to be strapped on to the saddle of a mule for removal. By this plan the natives are saved the trouble of condensing and preparing the milk for the market, by smoking. The large can of rubber milk on arriving at the magazine, is emptied into a bath of water, the temperature best suited to the rubber being a matter of experience. The lumps of rubber that form in the bath are immediately pressed into thin flat sheets, and carefully wiped. By this means the acid is forced out of the cells or pores in the lump, thus preventing the so-called "rotten" appearance.

Propagation.—Propagation may be by seeds or by cuttings. Seeds are the most convenient, but they soon lose their vitality. Cuttings are made from twigs that have begun to harden.

Trees in Jamaica.—There are young trees at both the Castleton and Hope Gardens, but they have not yet yielded any rubber. The bark is about $\frac{1}{2}$ inch thick, and the lactiferous vessels lie in the inner half of the bark. From examination made in the gardens, it would appear that this tree will succeed only in Jamaica grown as a forest tree with its bark shaded, and its roots in a soil which is constantly wet. It is quite possible that these conditions are more important than the rainfall, and that the tree might be grown in the swamps along the South Coast.

PARA RUBBER IN CEYLON.

As stated in the Kew Report for 1876, p. 8, Mr. H. A. Wickham, a resident on the Amazon, was commissioned by the India Office, to collect seeds of *Hevea brasiliensis*. He arrived in England on June 14th with 70,000 seeds obtained on the Rio Tapajos, and on August 12th following, about 2,000 plants raised at Kew from these seeds were despatched to Ceylon in 38 Wardian cases. Ninety per cent. of the plants reached their destination in perfect condition. A further consignment of 100 plants was sent in 1877, making the total number of plants transmitted to Ceylon 2,119 (Kew Report, 1877, p. 15.)

The following correspondence gives the first result of the experiment which affords anything like commercial data for deciding whether the cultivation of this staple would be a paying enterprise in the Old World:—

Dr. Trimen to Royal Gardens, Kew.

(Received February 6th, 1893.)

India rubber (2lb) from *Hevea brasiliensis* grown in Heneratgoda Botanic Garden, Ceylon, in 1892.

The tree from which this was obtained is now 15 years old, and the stem has a circumference of 6 ft. 5 in. at a yard above the ground.

It has now been tapped three times, and has given the following yield:—

In 1888 it gave 1lb. 11 $\frac{1}{2}$ oz.

" 1890 " 2lb. 10 oz.

" 1892 " 2lb. 13 oz.

Making a total of 7lb. 2 $\frac{1}{2}$ oz. of dry rubber in five years.

The tree is in no respect the worse for its treatment; the rest in alternate years permitting the scars on the trunk to become completely healed.

(Signed)

HENRY TRIMEN.

Messrs. Hecht, Lewis & Kahn to Royal Gardens, Kew,
21 Mincing Lane, London, E.C.,
7th February, 1893.

DEAR SIR,

We have received your yesterday's letter, and also the sample of Ceylon rubber which you have sent us. The quality of this rubber is very good indeed, and the curing of the same seems to have been effected in the proper manner. This quality would be easily saleable, and we estimate its value to-day as being about 2s. 3d. to 2s. 6d. per lb., according to whether the rubber would be dry or damp. It would be easily saleable in large quantities.

We return the sample to you, according to your desire.

We remain, &c.,

(Signed)

HECHT, LEWIS & KAHN.

John R. Jackson, Esq.,
Royal Gardens, Kew.

[Kew Bulletin, July 1893].

ASSAM RUBBER.

(*Ficus Elastica*, Roxb.)

Source.—Assam Rubber* is obtained from large trees of *Ficus elastica*. This fig tree generally germinates in the fork of another tree, sending down immense aerial roots into the ground and from the top of these (60 to 100 feet high) it throws out its branches.

Locality.—It grows in the damp forest which clothe the base of the Himalaya Mountains in Sikkim, and stretch away into Assam and Burma.

Effect of Soil, &c., on yield.—"As the distance from the hills increases, and the atmosphere in which the tree grows, gets drier, the quantity of rubber to be obtained from a tree decreases; and whilst it is stated by the men who fetch it from the hills, that one tree is able to produce from 2 to 3 maunds [160 to 240 lbs.] the men who gather it from the forests at the foot of the hills, only get from 20 to 30 seers [40 to 60 lbs.] per tree, and if far away from the hills, only half that quantity is obtained, especially if the ground is gravelly or otherwise severely drained". *G. Mann, Conservator of Forests, Assam.*

Yield.—In Algiers, this tree thrives, but does not form milk in sufficient quantity to make it a profitable source of rubber. Continuous tapping for 6 months year after year, Mr. Mann affirms, will kill the trees, and accordingly he urged either that tapping should be restricted to three months a year (January, February, and March), or that a regulation should be made prohibiting the tapping of Forests more frequently than once every three years. Mr. Mann further gives instructive figures as to the value of the rubber trees and their yield of caoutchouc. "Assuming that a tree reaches its full size at fifty years without tapping, and would after that yield every third year one maund of rubber, which would be collected, manufactured, and delivered in Calcutta at 15 rupees per maund, and should realise the present price of good rubber, viz., 35 rupees per maund, it would have a net profit of 20 rupees, per tree every third year. Besides this one

* The information about this rubber in India is chiefly derived from *Watts' Dictionary of Economic Products of India*.

maund of lac may be reckoned on from every tree per year, which, if collected at its present rate, could be delivered in Calcutta at 10 rupees per maund, whilst it fetches 15 to 20 rupees per maund, there now, which is a profit of 5 rupees at least per tree yearly. All these figures are the lowest, and the tapping the most cautious; still if the tree planted lives a second fifty years, which it is sure to exceed, it produces 320 rupees for rubber and 250 rupees for lac, which is more than any two timber trees of fifty years each, which might be grown in that time could equal."

Mr. Mann then deals with the two kinds of rubber manufactured by the people of Assam, viz., one in irregular solid lumps or loaves about 16 to 20 oz., in weight, and the other in balls of rubber threads each weighing 12 to 16 oz. The price paid (in 1869) for the two kinds varied, he says from 8 rupees to 12 rupees but this was paid for by pieces of Eri silk cloth of that value in exchange for a maund of rubber. This fetched in Calcutta from 20 rupees to 40 rupees per maund, but Mr. Mann adds "if care were bestowed on the manufacture, it beyond doubt would fetch much higher prices". Messrs Martin Ritchie & Co., however, purchased their rubber only in the fluid state from the people who tapped the trees. It was brought to them either in earthen pots or cane baskets made water proof with a previous coating of rubber. This coating of rubber Mr. Mann states, was held to retain the sap in its fluid state. He goes on to say that, rubber in this fluid state was first purchased at 8 rupees per maund, but soon rose to 5 rupees for the best or thickest procured from the aerial roots, and 4 rupees for the next best procured from the lower part of the stem, and 3 rupees for the worst supposed to come from the upper branches of the tree and to have been mixed with the juice of other species of Figs and water.

A full grown rubber tree of about 50 years old will yield at the very lowest 10 lbs. of rubber, if very carefully tapped, and this quantity may be expected about 16 times, which will be an equally safe estimate for calculating the yield of a rubber tree. To be quite on the safe side, calculate 10 trees per acre which would give about 1,600 lbs. of rubber from every acre. This, at the price at which rubber was collected in the Darrang district and sold, and deducting the expenditure incurred in collecting it, would give a net profit of 54 rupees per 80 lbs., or 1,080 rupees per acre in 50 years, and if the rubber trees have a longer life, the yield may be reckoned for their remaining years of life at the same if not at a higher rate.

Collection.—Among forest trees and in regard to dimensions, this is *facile princeps* and there is no other, not even the Banyan, that approaches it in dimensions and grandeur. Mr C. Brownlow points out that every portion below the head of the foster-tree is strictly root and incapable of throwing out a branch, and as the head is rarely less than 60 to 100 feet high, it is no easy matter to procure a branch. These cables and buttresses as they approach the ground, throw out smaller and subsidiary rootlets of all thicknesses down to that of twine. If any of these be cut they die below, but from above grow again downwards. It is only necessary to see the tree to appreciate the fearful risk encountered by the gum gatherers, who by no means confine their operations to the base but climb up as high as the roots ex-

tend and higher along the horizontal branches, chopping at intervals of every few inches, the cuts answering as well for their foothold as for the sap to exude from. Were the base of the tree alone tapped the yield would be very insignificant, especially in trees that have been frequently tapped before. And as the trees occur very sparsely, and long distances have to be gone over to meet them, it becomes an object to get as much off at each cutting as possible. The trees must be twice climbed, once to cut it and a second time after the gum has dried (which takes a day or two) to gather it. This is done by pulling off the tear which gathers below the wound, which brings away with it all the gum that has exuded, and these tears have only to be moulded together to agglutinate into a ball. The quantity that can thus be collected at one cutting does not exceed 8 to 10 lbs. Of course no mercy is shown to the trees, all of which suffer severely; and many are killed outright. The damage they sustain is apparent in the large cankers, and buttresses rotted off, owing to the bark being unable to heal over the frequent wounds they have received all round. The foliage is wanting in luxuriance, and dried branches and roots lying about testify to the injury in health that the tree has sustained.

Mr. Mann specially insists on the following points being observed :—

“ (1.) Fresh cuts to be made only in February, March and April, and the trees to have rest for two years between each tapping.

“ (2) The cuts to be at least 18 inches apart, to penetrate into the bark only, not into the wood, and to be made with an instrument more suitable than the ones at present used. Mr. Mann prefers the German timber scoring knife.

“ (3) As far as possible, the milk to be collected in a fluid state in narrow-mouthed rattan baskets, and to be brought to central manufactories.

“ (4) Endeavours to be made to convert the milk into a solid state by a process of slow drying similar to that practised in Para.

“ (5) Those varieties of caoutchouc which dry naturally on the tree to be collected with care, and to be picked so as to get rid of all impurities.

Planting.—In his report for 1884, Mr. Mann gives the following particulars :—“ The present area under cultivation is fully stocked, containing 12,511 trees : they have been planted at 25 feet apart in the lines, which latter are 100 feet apart : this is double the number of trees that was planted on an acre at the commencement. The oldest trees are about 30 to 40 feet in height, and a few from 45 to 50 feet but this cannot be put down as the average growth of *Ficus elastica* in ten years, since half this time and longer, these plantations were entirely experimental, and everything had to be learned, as, for instance, the first trees were all raised from cuttings, which mode of propagation has been given up, since the trees raised from seed have proved much hardier and faster growing, and as to the planting of rubber seedlings high up in the forks of other trees, this also has almost entirely been given up, because such trees in most instances, did not make more than a few leaves in the year, and it would, as a matter of course, be out of the question to plant rubber trees where they would take a century to become large enough for tapping, when such trees can be grown in a different way

in one-fourth of the time. On the other hand, it has been found that trees planted on small mounds of earth, 3 to 4 feet in height grow very much better than if they are planted on ordinary level ground, and this plan has therefore also been adopted, although it adds considerably to the cost of making these plantations, but the faster growth of the trees amply compensates for the higher expenditure. The method of planting adopted from the beginning has been to clear lines from east to west through the forest for the young trees a hundred feet apart: the width of the lines is 40 feet, so that a broad strip of forest 60 feet wide is left standing between these lines to ensure the utmost amount of moisture in the atmosphere for the young rubber trees. At first the lines were only cleared 20 feet broad, but it was found after a few years that these closed up very soon and thus retarded the growth of the young trees by shutting out the requisite amount of light. However, the widening of the lines also brought about the faster growth of the scrub in them, besides that of the rubber trees, and more money, time, and attention has in consequence to be spent, especially in the rainy season, on those plantations, than had at first been anticipated, but the greatest and most costly difficulty that had to be overcome was the effectual protection of rubber trees against deer, which during the first few years constantly bit off the young plants, and, where they were not entirely ruined by this, they were so much injured and retarded in growth that a considerable increase in expenditure on these plantations had to be incurred on fencing to prevent it. But for the future this expenditure will not be necessary, since it has been found that saplings 10 feet and more in height can be transplanted without difficulty and with perfect success, and if such saplings are tied firmly to stakes, the deer can do little or no damage to them."

Assam Rubber in Jamaica.—There are a number of these trees in various parts of Jamaica. Mr. W. M. Douet has extracted good rubber from a tree at Sweet River, near Sav.-la-Mar, by making V-shaped incisions with others leading into the lowest point. He says:—"By making several incisions in the roots, branches, and lower parts of the trunks I have extracted 2 lbs. from a tree at one time. The juice runs very slowly and hardens on the tree; I strip it off and roll it into balls. The trees are large, 12 to 15 feet in circumference and 50 to 60 feet high. They appear to be very old. The late Mr. H. O. Vickers made some experiments in extracting the rubber from these trees, and found that he obtained a greater flow at full moon, also during rainy weather... The average annual rainfall for the last ten years is 64 inches 17 parts."

Mr. M. S. Strickland has also extracted good rubber from one of these trees at Great Valley, Flint River. He writes, "The manner in which the rubber is taken is a rough one; the trunk and branches are cut with a machette, a small lump of clay is taken to catch the milk as it drops, and formed into a ball. But the milk can be taken by cutting the tree and allowing it to drop into a calabash... The tree here would not do for cocoa shade, as it branches out 5 feet from the ground, and the branches are large and low. The roots run a long distance, and are also very large. The measurements are: girth of trunk, 16 feet; girth of nearest branch to ground, 8 feet. I estimate the height of the tree to be 65 feet."

Mr. W. Harris, Superintendent at Cinchona, made some experiments on three trees at Pleasant Hill just below the Hill Garden, by kind permission of Messrs Balguy and Turner. Incisions were made in the bark of the trunks, branches and one large root, but nearly the whole of the rubber was obtained from the trunk of the oldest tree. When any part of the bark was punctured, the milk appeared immediately, but the flow quickly ceased, though it could be prolonged by removing the milk as it flowed from the incision. Only about one-fifth of a pint of milk was obtained each day for three days from the three trees, making in all three-fifths of a pint. The following method was adopted in preparing the rubber: the milk was kept in the tins in which it had been collected until the following day in each case. Through evaporation of the water, it had become thick, but in order to hasten coagulation, boiling water was added. The milk readily mixed with the water and was easily removed from the tins. The whole was poured into saucers, and placed on the top of a cooking stove. The rubber soon coagulated, was removed and pressed out into flat pieces. This is a sufficient indication of the plan that might be adopted on a large scale. The total amount of rubber thus obtained amounted to 4 ounces, which shows that this rubber tree would not be profitable at an elevation of 3,500 feet.

Preparation of the rubber in Assam.—Collins states that the preparation on a commercial scale is to pour the milk into large wooden bins, 6 feet square, and partly filled with water, the caoutchouc after a time floating on the top. The caoutchouc (being still fluid) is then taken out and boiled over a slow fire in iron pans, 4 to 6 feet in diameter, and 2 to 2½ feet deep, 2 parts of water being added to the caoutchouc, and the whole stirred constantly. As soon as the caoutchouc coagulated into a mass, it was taken out with iron forks and pressed, and again boiled and pressed, and then dried in the sun, and finally washed over with lime.

JAMAICA RUBBER.

Forsteronia floribunda, Don.

Jamaica rubber is not as yet known in commerce, though attention was called to it in the Annual Reports of the Department of Public Gardens and Plantations for 1883, and 1884, and again in Bulletins, No. 10 (January, 1889) and No. 21 (January, 1891).

Source.—It is derived from the juice of a climber known locally as the "Milk Withe" (*Forsteronia floribunda*), which is generally as thick as a man's wrist, sometimes much thicker. This withe is found in the woods, climbing to the tops of the highest trees; but it also grows over rocks fully exposed to the sun.

Soil, &c—The Geological formation is the "White Limestone". The surface of the ground is exceedingly rough and difficult to traverse on account of the sharp and jagged edges of the hard crystalline limestone. The soil is lodged in hollows of varying extent and depth between the projecting limestone blocks.

Collection of Milk.—When a cut is made through the bark of the Milk Withe a milky juice flows out for about two minutes, but a number of incisions are necessary before sufficient fluid is collected to fill a four-ounce bottle. Care should be taken not to cut into the bark

deeper than is necessary so that the wound may soon be healed by the formation of new bark.

Yield.—Messrs. Silver of Silvertown India Rubber Company reported on samples sent to them in 1888 that one quart of juice yielded one pound of dry and washed caoutchouc, or about 22 ounces of ordinary crude caoutchouc, but the sample sent in 1890 yielded only at the rate of two ounces per quart. Probably the difference was due to collection in the former case during the dry months and in the latter during the wet season. The value of the rubber in 1890, was stated by Messrs. Silver to be 3s. 2d. per pound.

Preparation of the Rubber.—The rubber coagulates simply on exposure to a dry atmosphere, but from experiments made, it is probable that the method described under Assam Rubber as the one used on a large scale would prove the most successful.

Propagation.—This plant may be propagated by seed, or readily by cuttings.

COLOMBIAN SCRAP OR COLOMBIA VIRGEN RUBBER.

Mr. Robert Thomson, of Bogota, Colombia, in 1888 described this rubber as follows, as reported in the *Kew Bulletin*:—

"This rubber is known in commerce as Colombia Virgen. It has been exported chiefly to the United States, and next to the Para rubber, it has realized the best prices in the market.....

"I have established in this country during the last five years a plantation of this rubber, consisting of about 70,000 trees, this being, I believe, as yet the only plantation made of this sort. Under cultivation this tree thrives admirably, growing with great rapidity, and averaging about five feet a year.

Crops are obtainable in from six to eight years, but a tree five years old yields as much as 1 lb. of rubber. It is a large forest tree, the trunks attaining six and seven feet in circumference. Four *arrobas* (100 lbs.) of rubber have been extracted from a single tree, but the average yield is far less

"The important consideration as regards this species, apart from its intrinsic value, is that it grows at great elevations on the Colombian Andes, viz., at from 6,000 to 8,000 feet above the sea.

"Prior to the wholesale destruction of this tree (but few now remain) by the rubber collectors, I explored some five years ago, the forests wherein it abounded in order to examine the soil, climatic and other conditions affecting its growth. It may be mentioned that its area of distribution has been peculiarly limited to a small section of the Cordilleras some 1,500 miles from the sea. The total quantity of rubber exported during the few years the article existed could not have amounted to many hundred tons.

"It is very difficult to propagate the tree from cuttings, hence I have had to resort, during my supervision of the plantation, to propagation from seed, which, moreover, were always procured with much difficulty."

Messrs. Hecht, Levis, and Kahn, write in May, 1890, to Royal Gardens, Kew:—

"We beg to say that Colombian scrap rubber has been known in the market for the last few years, and is of a very superior quality indeed.

It would be difficult to give you the exact average market value, but it has varied during the last few years between 2s. 3d. and 3s. per lb.

At the present moment the value is about 2s. 11d to 3s."

This rubber tree would be an important addition to the products of Jamaica, as from the data given by Mr. Thompson, it is probable that it would grow on the Blue Mountains above the range for coffee.

SUGAR CANE DISEASE.

SIR,

The attention of Sugar Planters was directed in the Jamaica Bulletin (Nos. 43 and 45, and Parts 2, 3 and 4) to diseases in Canes which have done much damage in Barbados and other West Indian Islands,

The most deadly of these diseases is due to a fungus attacking the stems, but I have seen no trace of this fungus (*Trichosphaeria*) in Jamaica.

Canes have also been attacked in Barbados and Java with a "root-disease," which is caused by a fungus (*Colletotrichum falcatum*.)

I investigated on an estate in Jamaica an affection of Canes, and traced it to a fungus in the roots, but was unable without specimens or drawings of *Colletotrichum* to determine whether it was the same.

Some of the roots preserved in spirit were brought by me to England, and have been carefully examined in the Jodrell Laboratory at Kew. Mr. Massee has identified the fungus as *Colletotrichum falcatum*, on account of which was published in the Kew Bulletin, and reproduced in the Jamaica Bulletin for last February.

I do not think that there is any cause for alarm in Jamaica, if reasonable precautions are taken to stamp out the disease wherever it occurs. It may be known by the soft outer portion of the rootlets becoming soft and decayed when they are affected. The whole cane should be taken up and burnt. As the ground may be infected with the disease, it would be prudent not to plant canes in the same spot for at least a year, nor any plant of the same family, such as corn. Root-crops, such as Sweet Potato or fruits, such as Pine Apples, would probably not be attacked. Careful selection should be made of tops from strong and perfectly healthy canes for planting, and it would be advisable to get them from a district where the disease does not exist.

I have, &c.,

W. FAWCETT.

Director of Public Gardens and Plantations.

The Hon. The Colonial Secretary, Kingston.

PRESERVING MANGOES.

Now that Mangoes are in season, the following hints on preserving the fruit, by Mr. E. M. Shelton, of the Dept. of Agriculture, Queensland, may be useful:—

CANNING.

After peeling, the fruit is separated from the stones by slicing into pieces of convenient size; these should be stewed for a few minutes only, before pouring into the cans, in syrup strong or weak in sugar to suit taste or the fruit may be cooked in the can with syrup as before. There may be a difference of opinion as to the palatableness of canned mangoes. A considerable number of those persons who have tasted the results of our work have pronounced the canned fruit excellent, while others have declared their indifference to it. A like diversity of opinion, we note, holds respecting the raw fruit, particularly with those unaccustomed to its peculiar flavour. Mangoes stewed in the form of a sauce will be found a

welcome addition to any dinner table. "As good as stewed peaches," we have heard them pronounced.

MARMALADE.

Webster defines marmalade as "preserve or confection made of any of the firmer fruits boiled with sugar, and usually evaporated so as to take the form of a mould." Nearly in this sense the word "marmalade" is used in this essay. Peel and slice the mango, cutting close to the stone, and cook, using plenty of water. Boil until the fruit is thoroughly disintegrated, when the pulp should be run through the colander with the purpose of extracting the "wool." Sugar should now be added to suit the taste (about $\frac{3}{4}$ lb. to the pint of pulp,) and the mass boiled until clear, when it should be poured into the moulds or jars in which it is to be kept. This marmalade is of a rich golden yellow colour, it retains the form of the mould perfectly, and it seems in all respects to satisfy the most exacting taste. In the absence of the experience necessary to test the keeping qualities of mango marmalade, it would be the part of wisdom to seal the jars designed for future use while hot with wax, or better yet, with a plug of cotton wool.

JELLY.

For jelly, prepare the mangoes by slicing as for marmalade, boil the fruit with water, prolonging the boiling only to the extent of extracting the juices. Great care should be taken in boiling as the mango rapidly "boils to pieces," in which case it is impossible to make satisfactory jelly. Pour off the juice strain and boil down to a jelly an operation that occupies only a few moments, as the mango is rich in gelatinous materials, the pulp remaining after the jelly has been removed may be used to advantage in making marmalade. In the amount of sugar used in making jelly, the housekeeper is safe in following old practices in this respect with other fruits. It is impossible to give exact rules in all the operations connected with working up this fruit. In general it will be well to use in boiling, water somewhat to excess, and as the mango "cooks" readily, constant watchfulness is needed to prevent burning.

To show something of what is possible in the way of results with this fruit, I may say that in our experiments thirteen good sized mangoes gave one pint of jelly and five quarts of marmalade. This certainly must be counted a very favourable, not to say remarkable result.

THE CULTIVATION OF VEGETABLES.

The cultivation of the better kinds of vegetables is slowly but surely finding favour amongst the peasantry of the upper parts of St. Andrew, as they are beginning to find out that it is no more trouble to raise superior kinds of cabbage, peas, beet, carrots, turnips, &c., than the coarse kinds which they had been accustomed for years to grow, and also that they can find ready sale, and command higher prices for the superior kinds. There is no reason, however, why they should not grow a larger variety than they do, and grow them in quantity too. The soil is admirably adapted to the successful culture of a large variety of delicate and wholesome vegetables, and that they could be easily disposed of at highly remunerative rates there is not the slightest doubt, as "scarcity of good vegetables" is a universal cry. The great fault to be found with those who grow vegetables is that they make no effort to keep up a continuous supply—a succession of crops. A man grows a few cabbages, turnips, carrots, beet-root and peas once a year and thinks he does something wonderful, whereas he might raise a crop of the same things, and many others every month or six weeks of the year, and thus keep up a constant supply. Then, again,

few of the growers know exactly when to gather the respective crops; they are either gathered too soon, before the flavour of each is fully developed, or are allowed to remain so long as to become tough and fibry. One rarely gets a dish of nice green-peas, for instance; they are either gathered before they are half their natural size, or are allowed to remain on the stems till they are nearly ripe enough for seed. Beet-roots again, are generally allowed to remain in the ground till they become old and woody, consequently almost flavourless and not worth cooking.

This might be remedied somewhat if purchasers of vegetables would take a little trouble to explain to the growers when the various kinds offered for sale are at their prime. We cannot yet expect too much; one point, and the principal one has been gained by their being induced to grow European vegetables at all; sooner or later they will see that it is to their advantage to cultivate them with care, and to take them to market in the best possible condition. There is another point, however, which deserves the serious consideration of small growers, and that is the promiscuous method of planting followed by the majority of them, and which generally ends in failure and disappointment. Their motto is "*multum in parvo*," which may be carried out if gone about in a methodical manner, but when indiscriminate planting is resorted to, without the least regard to order, or the requirements of the several things grown, failure must be the result. It is no uncommon thing to see in a small patch of ground, yams, sweet potatoes, corn, cassava, sugar cane, red peas, cabbages, turnips, a pumpkin or two running wild, a few coffee bushes, and the whole under the dense shade of bananas and plantains, and choked with grass and weeds. Cultivation under such circumstances cannot be a success. The same number of plants might be grown in the same plot of ground, but the plot should be sub-divided, and each division planted with one kind of crop. No more labour would be required, finer crops would be the result, and failures and disappointments less frequent. The successful vegetable grower must go about his work in a systematic manner, from preparing the seed beds or boxes, till his produce is fit for table. The ground, too, should be cropped systematically; if a piece is planted with cabbages this season try it with turnips next, peas the following and so on, but there should be a regular rotation of crops, the same thing should not be grown for two seasons in succession on the same piece of ground, and when the plot is properly sub-divided this system is easily followed. After a few seasons of such cultivation the grower finds out which vegetables thrive best in his soil, and also the months of the year in which they do best, *e. g.*, cabbages may be a failure with him in summer but may thrive well during the winter or spring months, and the observant and systematic grower will take care to have a vacant piece of ground for cabbages at the season when he knows from past experience they are going to be a success with him. *Experience*, every thing depends on that; every grower must find out by experience what his ground is capable of producing; his neighbour a mile or two away, and perhaps several hundred feet higher or lower, may grow good potatoes, turnips, carrots or what not, but he must find out by experiment and *experience* what his own land can produce, and once he has gained that experience it is invaluable to him. He knows exactly what to plant, and when to plant, and unless something unforeseen occurs he may reasonably look forward to success. At the same time the grower who is anxious to succeed may get useful hints and information from his more successful neighbour, and he would do well whilst gaining experience to test such hints and information, and he may profit by them. A mutual interchange of opinion in this, as in other cases, often leads to good results.

I have mentioned that many more kinds of vegetables might be grown,

or at any rate given a trial, and will now enumerate a few. In the Parish of Manchester, and probably other parts, I understand that a large number of kinds of excellent vegetables are grown, but my remarks have special reference to the hills of St. Andrew, with which I am more intimately acquainted.

Artichokes.—Procure offsets or suckers and plant in groups of three or four, at least four feet apart in good, open, rather sandy soil, thoroughly dug up and well manured. If planted early in the year these will produce heads during the summer and autumn. When gathering the heads cut the stems close to the ground and new suckers will be produced, and these, if carefully thinned, will produce a late crop. The artichoke is a good vegetable and much liked by many people, but is seldom to be obtained here.

Beet-root.—This is grown to a small extent, but in a very indifferent manner. The seeds should be sown in drills 15 inches apart where the crop is to grow, in a deep, well manured and well pulverized soil in the open. The seedlings should be thinned as soon as large enough to be handled to 8 or 9 inches apart. When ready for use the roots should be lifted very carefully so as not to bruise or injure them, and the tops should be screwed off, not cut. If at all injured they lose their colour and flavour in boiling. There are numerous varieties of Beet, but probably the best for cultivation here, where the soil during dry weather often becomes caked and hard, are the turnip rooted sorts.

Celery.—Sow the seeds thinly in a box of fine soil, and as soon as the plants have made two or three leaves they should be pricked off into boxes of light soil to which has been added some fine, rotten manure, and when they are strong enough they may be planted out in the trenches. The latter should be 4 feet apart, 18 inches deep and about 15 inches wide. In the bottom of each, place a good layer of perfectly rotten manure, over this spread a couple of inches of fine soil and put out the plants, in showery weather if possible, but if not then the young plants should be well watered. As the plants increase in size they should be earthed up with the soil from between the trenches to blanch them. At each earthing up, the soil should be pressed pretty firmly around each plant to exclude light and air and ensure blanching.

Cucumbers.—It is usual to soak the seeds in water for a few hours before sowing; this softens them and causes them to germinate quickly. It will be found, too, that the good seeds sink after a time and bad ones float and are thus easily detected. Ridges or hills should be prepared and the seeds planted not less than 4 feet apart. The roots should be top-dressed about once a fortnight with good manure mixed with soil, and they should never be allowed to suffer for want of water. When the plants have made three leaves they should be stopped. This will cause them to throw out side shoots which should also be stopped, and the vines will soon spread in all directions and cover the ground. Some long, dry grass should be laid under the fruits to keep them clean. If the grower chooses to go to the trouble of making a temporary arbour over which to train his plants, he may expect to be rewarded with much handsomer and finer fruit.

Leeks.—Sow the seed in a box in the month of January. If the seedlings come up too thick, they should be thinned to about an inch apart, and those that remain should be planted out in trenches when they are about as thick as a goose quill. The trenches should be prepared in the same way as for celery, but need not be so deep and only 9 to 12 inches wide and about 18 inches apart, and the distance from plant to plant in the trenches should be 9 or 10 inches. They should be earthed up in the same way as celery to blanch them.

Lettuce.—These may be had all the year round. Sow the seed in a box. As soon as the seedlings are large enough to handle dibble them out in rows in a piece of ground that has been well dug up and manured. As they are of very quick growth, a row of Lettuce may be planted almost anywhere in the well-tilled garden amongst young cabbage, or between the rows of celery, or leeks. Snails, &c., are very fond of tender Lettuce, but a little soot, lime or wood-ashes placed within the rows, or round the plants will stop their depredations.

Cabbage Lettuces are best for culture here, as they form heads much more freely than the Cos varieties.

Parsley.—This should be grown in every garden. The seeds may be sown in drills 10 or 12 inches apart or along the edges of beds. The ground should be previously dug to the depth of at least a foot and well manured. The plant is biennial and once fairly started into growth gives no further trouble.

Parsnips.—The ground for these, as for carrots, &c., should be worked deep to allow the roots to penetrate freely, or they are liable to become forked. Sow in drills in March or April, and again in November, 1 inch deep and 18 inches apart. All that is needed afterwards is to thin the young plants to about 12 inches apart, and keep them free from weeds.

Radishes.—Sow thinly in beds anywhere in the garden. Only sow a little at a time, but successional sowings should be made every three or four weeks to keep up a constant supply.

Salsafy or Vegetable Oyster.—Sow the seed in drills 10 or 12 inches apart where the plants are to remain. The seedlings should be thinned to 6 or 8 inches apart. The roots are eaten boiled, and the young tender leaves make a very good salad.

Scorzonera.—This requires the same treatment as Salsafy, and is used in a similar way.

Garlic.—Plant the bulbils in shallow drills, 1 foot apart, and allow a distance of 6 inches between them, and cover to the depth of 2 inches with fine soil. After the leaves have turned yellow, the bulbs may be taken up dried, and hung up in bunches in an airy room or shed.

Every garden should have its patch of pot herbs such as Thyme, Sage, Sweet Marjoram, Basil, Borage, Mint, &c. Mustard and Cress should also be sown frequently in every garden.

I have said nothing here about Tomatoes, Garden Eggs, Melons, Gourds of various kinds, Indian Kale, Kohl Rabi, English Peas, Turnips, Carrots, &c., as their culture is fairly well understood, although they are not much grown. There is no reason, however, why they should not be largely grown, as they are of easy culture and give quick and profitable returns. Excellent Irish Potatoes are grown, but the supply is never equal to the demand, and the prices asked for them are generally exorbitant.

W. HARRIS.

UTILIZATION^a OF BANANAS FOR MEAL, ALCOHOL, &c.

Stanley's work "In Darkest Africa"^b called the attention of the world to the dietetic value of bananas, especially for invalids. Since that date experiments have been made for the purpose of so preparing

^aPage 240. "We had often wondered during our life in the forest region, that the natives did not appear to have discovered what invaluable nourishing and easily digestible food they possessed in the plantain and

bananas that they might be made use of in all climates, not merely as fruit, but in the form of meal to be cooked as gruel, puddings, &c.

In Jamaica it is of great importance to discover some plan for the utilization of the fruit, which at present is wasted,—the small bunches, and those that are unfit for export for other reasons, such as bruising or over-ripeness.

A Committee of the Board of Governors of the Jamaica Institute, with the Director of Public Gardens as Chairman, investigated this subject some time ago, but the conclusion arrived at then was that the data in their possession were not such as to encourage any hopes of planters being able to manufacture the waste bananas themselves or dispose of them to a factory. The Director has, however, been making enquiries in London, and has had an interview with a Dutch engineer, Mr. Hartogh, who has invented machinery for the conversion of bananas into various products. The specimens seen of these products were of excellent quality, and it is interesting to note that the peel can be used in certain cases for manufacture as well as the pulp of the fruit. The prospects of this new industry are now more hopeful, and it seems probable that factories will be started in Jamaica for the utilization of bananas that now are wasted.

Mr. Hartogh, after seeing the references to bananas in Stanley's book, visited Dutch Guiana in 1892, with the object of studying the preparation of bananas so as to utilise the large proportion of starch contained in them for food, and for other industrial purposes. He invented various machines, and has prepared different products from the banana, which have been submitted for analysis and test to specialists in all the industries in which starch products are employed.

Whether his special methods are of such a nature as to be profitable both to the planter and the manufacturer, the results of the tests to which the products have been submitted will be interesting to all growers of bananas. They have been published in connection with an exhibit in the Antwerp Exhibition of this year, made by the "Stanley Syndicate," which has been founded by Mr. Hartogh, and by Mr. Asser, Civil Engineer at the Hague, who acts as Secretary. An experimental factory has for some time been at work in Dutch Guiana.

Among others, experiments on a large scale have been carried out in Mr. KALHKE's *manufactory of yeast and alcohol* at Königsberg, and at his request in a laboratory at Berlin. An account of these experiments was published in the weekly paper "Alcohol," in its numbers 10, 11, 12 and 15. The use of banana flour is regarded in this periodical as opening a perfectly new prospect for the industry in question. It is affirmed that the richness of banana flour in starch is in a special state which facilitates in a most remarkable manner the production of

"banana. All banana lands—Cuba, Brazil, the West Indies—seem to me to have been specially remiss on this point. If only the virtues of the flour were publicly known, it is not to be doubted but it would be largely consumed in Europe. For infants, persons of delicate digestion, dyspeptics, and those suffering from temporary derangements of the stomach, the flour, properly prepared, would be of universal demand. During my two attacks of gastritis, a light gruel of this, mixed with milk, was the only matter that could be digested."

yeast without diminishing the quantity of alcohol. The latter has a fine aromatic flavour.

Mr. KAHLKE, one of the best known manufacturers of yeast in Germany, writes in this connection : "Banana flour, without doubt, from its richness in starch and its good flavour, is particularly suitable for the manufacture of yeast. This flour is easily rendered saccharine. The yeast obtained by adding banana flour to the other ingredients has a good colour, all the requisite properties of an excellent class of yeast, and moreover, keeps well. The alcohol obtained from it leaves nothing to be desired, so that this flour may be introduced as an article of commerce and employed without any special preparation."

Satisfactory experiments have also been made in some breweries where 20 o/o of malt has been replaced by the flakes and flour of bananas. The flavour of the beer was not altered and the quantity of liquid was increased, and the malt was replaced by a less expensive substance.

Experiments are being made in which the proportion of banana flour is increased. One of the great Belgian brewers writes :

"These flakes were macerated in the vat with the malt and the result was much superior to that of maize and the flavour of the *must* irreproachable ; the drainage of the mixture was a little difficult at first, but after being stirred a second time the draining proceeded rapidly ; briefly, the use of the flakes may be considered both advantageous and easy in brewing".

Different banana flours, and notably that prepared specially for the manufacture of glucose, have been tried in some *glucoseries*. Although difficulties were met with in the manufacture, principally with respect to discoloration, it has been shown that the glucose obtained from it has a good flavour, is very sweet and slightly aromatic.

It is highly probable that a special study of the subject will surmount the slight difficulties which at first presented themselves in the use of this new product in *glucoseries*.

Very nourishing bread has been made from equal proportions of bananas and wheat and rye flour, and even from a mixture of $\frac{2}{3}$ banana and $\frac{1}{3}$ ordinary flour.

A sweet banana flour having an agreeable flavour of fresh fruit appears to be specially suitable for cakes and biscuits.

SCIENCE A NECESSITY FOR SUCCESSFUL AGRICULTURE.

At no period has science so largely benefited agriculture as at present, and the time has long since past when there is nothing to be done but to plant the seed in the spring and gather the harvest in autumn. While agriculture has made much advancement during recent years, yet it has hardly kept abreast of the times during the last decade, and some of the other industries have pushed ahead of this most ancient and honourable occupation. Agriculture has excluded itself too much from the other lines of industry, and is just now coming abreast of the times through the aid which science has rendered. This is particularly true in some special lines. Farm crops are attacked by two kinds of organisms—the injurious insects and the

parasitic fungi—and it is in dealing with these that perhaps the most advancement in scientific agriculture has recently been made. The insects eat the leaves and suck the sap of the plants, while the parasitic fungi feed upon the rich juices of plants, causing a great check in growth. How much damage is caused by injurious insects and parasitic fungi cannot be estimated in just so many shillings and pence, but it is safe to say that fully one-fourth of the average yield of all farm produce is destroyed by injurious insects alone. That is to say, that were it not for the insects, the yield would be one-fourth greater than it is at present. To one who has not given this matter attention, this statement may be received somewhat doubtfully; but it is, nevertheless, only too true.

By the application of proper remedies a large part of the loss caused by injurious insects can be prevented, and that with but little trouble and expense. It is here that the science of entomology comes to the rescue of the agriculturist by bringing forward insecticides to lessen, and indeed in some cases to entirely prevent, the loss caused by the ravages of injurious insects.

In many cases the loss through damage by parasitic fungi is no less than that caused by the attack of injurious insects. The diseases of the grape have, perhaps, received the most attention at the hands of mycologists, and the beneficial results of their work in this branch of scientific agriculture manifest themselves on every hand. Grape diseases were formerly but little prevalent, but during recent years they have increased in their distribution and destructiveness to such an extent that it is now almost impossible to bring the grapes to maturity without the application of a fungicide to check the growth of the parasitic fungi which are the cause of the grape diseases. This being the case, the viticulturist knows that the application of the Bordeaux mixture is as fully an important part of success as pruning or cultivation. But it has also been recently shown that many plant diseases other than those of the grape can be checked in like manner by the application of fungicides. A prominent example of this is found in the good resulting from the application of Bordeaux mixture to potatoes, recent experiments showing that this fungicide not only prevents the potato rot, but also so very largely increases the yield that it would pay well to apply the Bordeaux mixture for this latter purpose alone, where potatoes are subject to early blight. This increase in yield was a result unlooked for when the experiments were conducted. This same fungicide is used in spraying apple trees to prevent the apple scab, and experiments last season at the Cornell station show that the Bordeaux mixture not only prevents the scab, but it increases both the yield and keeping qualities of the fruit.

But in other lines of agriculture, science has but recently shown many things of interest. The matter of sub-irrigation has received attention at the hands of some of our stations, and the experiments have shown that this system of irrigation is much superior in its results to the usual methods. Agricultural chemistry, dairying, and bacteriology are as yet but new sciences, and this is especially so in the intimate relations which they bear to each other. The matter of the fermentation of milk is now receiving much attention, and

bacteriology will probably soon show us a method of greatly prolonging the sweetness of milk. By a method of milk testing, we are now able to say just how much butter-fat a given amount of milk contains, *i. e.*, how many pounds of butter can be made from the given quantity of milk. This being the case, the milk now sold at creameries is paid for in proportion to the amount of butter-fat it contains. Thus we see the intimate relations existing between the sciences which underlie agriculture. We also see that science has brought agriculture forward to the state of advancement in which it now stands. That agriculture should be our foremost, as it ever has been primarily the most important, industry there can be no doubt. But science has not completed its work in aiding agriculture. Indeed, the results so far obtained but go to show the possibilities which lie beyond. Other equally important results in scientific agriculture may be looked for, and if the agriculturist wishes to be successful, he should put the latest results of scientific investigations into immediate practice. The greatest aid to the agriculturist in this country is the experiment stations—and it is through these institutions that much of the future aid to agriculture will be brought forward.—(*American Agriculturist.*)

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 Revue Agricole. No. 5. May, 1894. [Conservateur.]
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 Chemist and Druggist. Nos. 738-745. June-July, 1894. [Editor.]

Times of Ceylon. Nos. 21-23. May-July, 1894. [Editor.]
 Minnesota Botanical Studies. Bulletin No. 9. [Dept of Agri.]
 Contrib. from Gray Herb. of Harvard University by B. L. Robinson. [Author.]
 New Commercial Plants & Drugs. No. 11, by T. Christy. [Author.]
 Plantas novas cultivadas, Jard. Bot. Rio de Janeiro IV. [Director.]
 Catalogue of Plants in Island of Penang by C. Curtis. [Author.]
 Report of Jam. Soc. of Agri. & Commerce. [Secy.]
 Report by Mr. Crowther on his recent visit to the W. Indies. [Col. Secy.]

SEEDS.

From Royal Gardens Kew.

Aloe marginata, *Polygala speciosa*, *Doryanthes adhatodes*, *Leucodendron argenteum*, *Strelitzia Reginae*, *Strelitzia augusta*, *Irvingia Barteri*, *Clematis Stanleyi*.

From Government Botanist, Melbourne.

Atriplex vesarium, *Atriplex nummularium*, *Atriplex halimoides*, *Calycotrix tetragona*, *Callitris verrucosa*, *Eucalyptus microcorys*, *Ficus* sp. (New Guinea), *Leptospermum myrsinoides*, *Pittosporum phylliroides*, *Podolepis acuminata*, *Marsilea Drummondii*, *Tecoma jasminoides*, *Xanthorrhoea Preissii*, *Mesembryanthemum australe*.

From Mr. Joseph Myers, Manderiville.

Lace Bark Seed.

From Botanical Gardens, Mauritius.

Acanthophaenix crinita, *Corypha elata*, *Dypsis* sp., *Dictyosperma alba*, *Hypophorbe Verschaffeltii*.

From Botanical Gardens, Lagos.

Momodora tenuifolia, *Irvingia Barteri*.

From Botanical Gardens, Shibpur, India.

Dalbergia latifolia.

From Botanical Gardens, Saharanpur.

Onion Seed.

From Botanic Gardens, Bangalore.

Cassia montana.

From Botanic Gardens, Ceylon.

Erythrina Vespertilio.

From Botanic Gardens, Grenada.

Brownea grandiceps.

From Mr. T. Christie, London.

Maragogipe Coffee.

From Mr. J. C. Harvey, California.

Acacia juniperina, *Aristolochia elegans*, *Brahea* sp., *Erythrina Caffra*, *Erythra armata*, *Erythra edulis*, *Cooperia pedunculata*, *Heteromeles arbutifolia*, *Lathyrus splendens*, *Pritchardia* sp., *Washingtonia filifera*.

From Colonial Botanist, Brisbane.

Acacia decurrens, *Anthistiria membranacea*, *Astrebla pectinata*, *Astrebla elymoides*, *Bursera australasica*, *Archontophaenix Cunninghamii*, *Calamns Muellerii*, *Elaeocarpus cyaneus*, *Eucalyptus acmenoides*, *E. corymbosa*, *E. Baileyana*, *E. haemastoma*, *E. microcorys*, *E. Planchoniana*, *E. resinifera*, *E. saligna*, *E. siderophloia*, *E. tereticornis*, *E. trachyphloia*, *Gmelina Leichhardtii*, *Macadamia ternifolia*, *Macadamia Youngiana*, *Myrtus tenuifolia*, *Panicum decompositum*, *Pittosporum phylliroides*, *Pollinia fulbra*, *Polyosma Cunninghamii*, *Schizomeria ovata*, *Vitis hypoglauca*.

JAMAICA.

BULLETIN

OF THE

BOTANICAL DEPARTMENT.

New Series.] AUGUST & SEPTEMBER, 1894.

Vol. I.
Parts 8 & 9.

SHIPPING BANANAS AND PINE APPLES TO THE LONDON MARKET.

Mr. Gerald, of Messrs. J. B. Thomas, Ship Brokers, Covent Garden, states that large bunches of bananas, well selected, well packed, and arriving in good condition, obtain a price varying from 18s. to 35s. per bunch.

He advises that the bunches should be packed in crates—one bunch to a crate. Each bunch should be rolled once in a sheet of cotton-wool, and then wrapped in paper, which may be waste newspaper, or any other kind of paper.

The crates should have the shippers' mark on outside, and also a letter or number to indicate whether first class or second class.

It is better to ship by way of New York their agent there (Mr. Thos. P. Wallace, 187 Reade St.) would decide whether to forward or not. As soon as a shipment reaches Liverpool, fruit would either be sold there or sent on to London, according to the state of the market. From New York through freight would be paid to London, and if stopped at Liverpool, deduction would be made for rail between Liverpool and London.

Pine Apples should be wrapped in paper, and packed tight in crates, 24 to 30 in each crate. Those from Florida get from 1s. to 2s. each, those from St. Michaels 6s. to 8s. each.

TODD'S MACHINE FOR SISAL HEMP.

Hon. Col. Secretary, to Director of Public Gardens and Plantation,
10th July, 1894.

SIR,

I am desired by the Officer Administering the Government to forward herewith, for your information, a copy of a Despatch from the Secretary of State for the Colonies, with enclosures relative to a Machine for extracting Fibre from Sisal Hemp now in successful operation in the Bahamas.

I have, &c.,

(Signed)

J. ALLWOOD,

Downing Street, 2nd June, 1894.

SIR,

With reference to my Circular despatch of the 12th of August, 1893, I have the honour to transmit to you copies of a despatch from the Governor of the Bahamas, and of a letter* from the Director of the Royal Gardens, Kew, respecting a Machine for extracting Fibre from Sisal Hemp, manufactured by Mr. Todd, of New York, which is now in successful operation in the Bahamas.

I have, &c.,

(Signed)

RIPON.

The Officer

Administering the Government of Jamaica.

Bahamas, No. 64.

Government House, Nassau, N. P.,
24th April, 1894.

MY LORD,

With reference to communications, verbal and otherwise, that I have received from the Colonial Office during the past three years on the subject of Machines for the extraction of Fibre, on which information was desired for the Fiji Government, I have now the honour to acquaint your Lordship that I am at length in a position to speak definitely of a Machine that is now in successful operation in this Colony.

2. The Machine in question is one manufactured by a Mr. Todd,† of New York, and during my late visit to the Munroe Plantation at Abaco, I witnessed its performance and have no doubt it will be universally adopted here. It dresses the Fibre perfectly and with a minimum amount of waste, and though half a ton is all that a single Machine will yield as a day's work, the principle is so sound that all that is necessary is to increase the number to meet any required needs.

3. I may observe, however, it does not necessarily follow that the "Todd" Machine will be suitable where the conditions of the plant are not similar to ours—I am not informed of the nature of the plant at Fiji—but it may be instructive to know that the leaves of the Bahama Plant which hold the Fibre are from four to six feet long, that they are free from gum, and the threads separate without combing. Little washing is needed, and the whole process of extracting, washing, and drying is the work of one day.

I have, &c.,

(Signed)

A. SHEA,

Governor.

The Most Honourable,

The Marquis of Ripon, K.G., &c., &c.

Royal Gardens, Kew, May 22nd, 1894.

SIR,

I have the honour to acknowledge the receipt of your letter of May

* Gov. No. 64 24th April, 1894, Kew, 22nd May, 1894.

† Address—J. C. Todd, Patterson, New Jersey, U.S.A.

19th, transmitting a copy of a despatch from the Governor of Bahamas respecting the "Todd" Machine for extracting Fibre from Sisal Hemp.

2. This Machine is described in Report No. 5 "Fibre investigations in the United States," issued by the Department of Agriculture, pp. 25, 26. The Governor's despatch gives the first information as to its practical working which has reached Kew. As the success of the Sisal Hemp enterprise in Bahamas entirely depends on a satisfactory Machine being found for the purpose of cleaning the Fibre, the information contained in the Governor's despatch is decidedly encouraging. The price of Sisal Hemp is just now lower than it has ever been. It is quoted at £16. 10s. per ton, compared with £54 three years ago.

3. Sir Ambrose Shea correctly points out that "it does not necessarily follow that the "Todd" Machine will be suitable where the conditions of the plant are not similar." In Fiji the most plentiful species is *Furcraea gigantea*, or Mauritius Hemp. It is possible that the "Todd" Machine may clean *Furcraea* leaves, but it cannot be assumed.

4. The attention of the Governor of Fiji should be drawn to the Mauritius Machine as likely to answer his purpose. It is described in the Kew Bulletin, 1890, pp. 98-104. It is very cheap, can be easily worked by a low horse-power, and attended by Indian coolies.

I am, &c.,

(Signed) W. T. THISTLETON-DYER.

Edward Wingfield, Esq. C.B.,

Colonial Office, Downing Street, S. W.

TREATMENT OF DISEASED SUGAR CANES IN THE WEST INDIES.

[From the Kew Bulletin for June, 1894.]

In consequence of the appearance of disease affecting sugar-cane in the West Indies, great attention has been devoted to the subject at Kew, and in the course of official correspondence with the Colonial Office, and with local authorities in the islands concerned, various recommendations have been made with the view of enabling the sugar planters to deal effectively with it.

FUNGOID DISEASE.

The diseases chiefly engaging attention at the present time are the rind-fungus (*Trichosphaeria sacchari*), and the root-fungus (*Colletotrichum falcatum*.) It is possible that these may eventually prove to be different forms of one and the same species, but the investigations on this point have not yet been completed.

There is apparently a danger that attention is being diverted in the West Indies over too wide a field, and that the few, but really destructive enemies of the sugar cane are likely to be overlooked. The recommendations made from Kew have, therefore, been confined to certain well-established facts, and to precautions and treatment calculated to improve the industry generally. For instance, it has been sought to impress upon those engaged in sugar growing, in the first place, to select only the best and strongest canes for planting purposes. This

is a matter so obvious that it would hardly seem necessary to mention it. There is, however, sufficient evidence to show that, following the routine practice of a bygone age, cane-tops for planting are too often taken from weak and worn-out canes, and even from those which are actually diseased. When this is done disease in the cane-fields is inevitable. Not only so, but the disease every year takes stronger hold of the cane-fields, until at last the cultivation threatens to become unproductive.

Another point dwelt upon is that the diseased canes, directly they show themselves, should be cut out in the fields and burnt. This precaution would prevent the spread of the disease during the season of growth, and allow the healthy canes to fully mature before they are cut. Lastly it has been recommended that after the canes are cut and the crop is over, the stubble and refuse left on the fields should be burnt. This would tend to cleanse and purify the land by destroying the spores, and afford hope for more immunity from disease for the next year's crop.

These, briefly stated, are the general measures, which, if steadily and carefully pursued, must gradually stamp out the disease in all the islands. It will be noticed that they require no special appliances or material; they can be carried out by each planter without considerable expense, and with no technical skill or knowledge necessary beyond what is possessed by every sugar planter in the West Indies.

So far, however, although the mischief effected by disease is already serious, the action taken locally has not been at all commensurate with the gravity of the situation. Valuable time has been lost, and the position has been steadily getting worse instead of better.

It is all the more noticeable to find that in the island of St. Vincent definite action has at last been taken, and a committee appointed to inquire into the disease of sugar canes in the island has presented a Report which it is hoped will stimulate action in the other islands. A copy of the St. Vincent Report has been communicated to Kew by the Secretary of State for the Colonies. It embodies the views of experienced planters on the spot, and it appears to be drawn up with excellent judgment and foresight. If the recommendations of this Report could be vigorously carried out on all the sugar cane estates in St. Vincent, the results in a few years would not fail to be most beneficial. In order to give as much prominence as possible to the recommendations contained in it, the Report is reproduced.

Report of the Committee appointed to inquire into the Disease of the Sugar Cane in the Island of St. Vincent.

1. The Committee appointed at a meeting held at the "Planters' Club" on the 13th inst., met on the 21st and 28th instant, and after full discussion and careful consideration, passed the following resolutions:—

(1) That in the case of pieces or cane-fields not to be ratooned,

(a) All stools should be stumped out and then the pieces within fourteen days be burnt. (b) Immediately after the burning all unburnt or partially burnt stools, canes, tops, bush, rubbish, or other vegetable matter should be most carefully collected, placed in heaps, and burnt to ashes.

- (2) That in the case of pieces to be ratooned,
 - (a) The pieces should without exception be thoroughly burnt off within *14 days at the utmost* after cutting. (b) Immediately after the burning all unburnt canes, tops, bush, rubbish, or other vegetable matter should be most carefully collected, placed in heaps, and burnt; and (c) After the stools have sprouted and subsequent to measures (a) and (b) young canes showing the slightest weakness or indication of disease be without fail cut out from the base of the sprouts and burnt.
- (3) That in the case of plant canes,
 - (a) That the plants be taken from fields unaffected by any disease, and the greatest care be observed to most scrupulously examine the plants themselves and to throw out all but the strongest and healthiest-looking; (b) The plants selected for planting be stripped and soaked in a strong solution of temper lime and water, or other mixture known to be fatal to the fungus or borer; and (c) After the plants have sprouted, every sprout or young cane showing the slightest weakness or indication of disease be without fail pulled up and burnt.
- (4) That in the case of all supplies, whether for plants or ratoons, the same course be pursued as recommended in resolution (3). All dead plants taken out when supplying, be burnt outside the piece.
- (5) That immediately after burning the banks should be broken and manure or green dressing be put on them.

2. As regards resolution (2) (a) the maximum limit of 14 days has been recommended in order to leave it to the discretion of planters to burn within a day or two after the cutting of the piece, or to delay the operation until after the stools have sprouted, *not later than 14 days after cutting* to suit the nature of the soil and the opinion of the individual planter.

3. The members of the Committee, whilst hitherto more or less fully convinced of the absolute necessity of some such course, have now become positive as to the dire necessity for carrying out immediately the measures recommended, or others, as experience may hereafter prove as more efficacious, with intelligence, energy, perseverance, and above all, unity of purpose, as they find that precisely the same measures were enforced by legislative enactment by the Government of Mauritius some 20 years ago, as the only possible means of freeing their agriculture, within a few years, of an insect (the borer) which threatened it with certain ruin, and also from the terms of the letter from Mr. W. Thistleton Dyer so recently as March, this year, forwarded to the Government of the Windward Islands by the Secretary of State in a despatch dated 24th ultimo., on the subject of the fungus in Barbados.

4. The Committee, therefore, as the only means of securing universal and combined action throughout the Colony, urge in the most pressing manner on all proprietors of estates, and on all and any persons having or growing canes, the necessity for carrying out the measures above referred to, and, in the event of their not being carried out, suggest that the Government be asked to legislate so as to render these measures obligatory later on.

Moved by Mr. Campbell and seconded by Mr. H. A. Hazell, that the foregoing resolutions be adopted and submitted to the President of the Planters' Club and the Chairman of the meeting, the Honourable C. J. Simmons, with a request that they be printed and circulated without delay to all proprietors and cane-growers, urging on them the desirability of instructing the managers and others to take the necessary prompt action, and that a copy of the resolutions be inserted in the local paper, and a copy sent to His Excellency the Governor-in-Chief, and to His Honour the Administrator with a request that he will cause the same to be published in the next issue of the "Government Gazette."

(Signed)

J. G. COULL, Chairman.

28th April, 1894.

INSECT PESTS.

One of the most striking features of the reports that reach Kew is the prominence still given to the injuries caused to sugar-cane by the moth-borer (*Chilo saccharalis*) (figured in the *Kew Bulletin*, 1892 p. 153). This was first described by the Rev. L. Guilding from St. Vincent specimens in 1828. There is little doubt that it has been present in the West Indies for the last hundred years. It is now probably found in every part of the world where the sugar-cane is cultivated. The other Insect Pest is the shot-borer (*Xyleborus perforans*) fully described with figures in the *Kew Bulletin* 1892 pp. 153-178.

The loss sustained owing to the attacks of these insects must be very large, and yet there is apparently little or nothing being done to lessen it.

In a letter received from Mr. Henry Powell, Curator of the Botanic Station at St. Vincent, dated the 23rd November last, he describes a visit paid to several sugar-estates at the invitation of the proprietors to examine the canes. In one instance he states: "During our interview about half-a-dozen canes were brought in for our inspection, one of which was riddled by the moth-borer." In a field of canes lately stripped "the presence of the moth-borer which had not been observed before, was disclosed in considerable numbers." Its presence in nearly mature canes "can readily be detected by the yellow tops, showing the cane to be injured beyond recovery." In riding through another estate, "the presence of the moth-borer was seen on all sides, but on two fields the borer and other pests had become thoroughly established." In another instance "the canes were most luxuriant, but already the moth-borer was playing great havoc amongst them and was steadily on the increase."

In the Leeward Islands the moth-borer appears to be equally rife. Mr. C. A. Barber, F.L.S., Superintendent of Agriculture as lately as the 16th April last, reported to his Government: "The fungus (*Trichosphaeria*) is our greatest enemy." Mr. Barber places the destruction of the moth-borer "as the first duty of the planter." He goes on to state, "it is almost impossible to obtain a cane of any variety unaffected by the moth-borer." Each moth I have captured has laid 50 to 150 eggs, and in one lot I hatched 97 per cent. of the grubs. From this it will be seen that the supply is practically unlimited, I

have observed as many as 12 in my own drawing-room in a couple of hours, although there is no cane field immediately to windward."

A valuable summary of information respecting the moth-borer is given in *Indian Museum Notes*, Vol. I., pp. 22-27, pl. ii. The means hitherto adopted to get rid of it are given in the following extract:—

A large number of remedies has been proposed for the pest, and it seems to be pretty well established that it can be to a great extent controlled by the burning or burying of all the discarded tops, and clearing the fields of all waste sugar-cane stalks after the crop has been taken; for, as the insect passes the winter as a larva inside the sugar-cane, if these are destroyed, there are not moths in the spring to lay the eggs which produce the next year's borers." The waste tops, however, should be carefully gathered together and removed from the field before being burnt, for if they are burnt carelessly on the field itself, many predaceous insects will be liable to be destroyed, which take shelter in the ground and assist in reducing the number of the pest.

"The following may be noticed among the remedies that have been suggested:—

"Guiding recommends that all the dry and useless leaves, under which, he says, the moth lays its eggs, should be stripped off; he claims that this treatment has been found effective in removing the pest.

"Porter quotes the practice of "introducing a pinch of quick lime into the heart of the young cane" for the destruction of the pest.

"Westwood notices that in Jamaica in 1841, the ravages of the borer were to a great extent checked by allowing the refuse to accumulate upon the grounds, and burning them there, the old roots subsequently throwing up more vigorous shoots.

"Miss Ormerod in writing of the pest in British Guiana about the year 1879, quotes the practice of cutting back the cane below the surface of the ground, covering the plant with mould, and adding a handful of lime. The cutting out of the affected canes was tried on one estate over 246 acres, the result being considered satisfactory. In this case the canes cut out were put through the mill and sufficient rum and megas obtained from them to pay expenses. Miss Ormerod also quotes the practice of steeping the cane for 48 hours in water before planting it, a treatment which was thought, on one plantation where it was tried, to destroy the hibernating larvæ without injury to the cane. It appears from the inquiries instituted in British Guiana, that it is a mistake to burn the refuse sugar-cane on the fields themselves, as this destroys the ants, which, when unmolested rendered valuable assistance in keeping down the pest. The plan therefore approved was to burn the refuse cane after collecting it in heaps, outside the fields.

"Dr. Riley recommends burning all "tops" during the winter so as to destroy the larvæ which hibernate in them: selecting seed-cane from the least infested portion of the plantation and laying it down in furrows during the winter, covered with earth as deeply as should be found possible without inducing decay, and only uncovering it as it is wanted in the spring for planting out, thus preventing the egress of moths from the larvæ which have hibernated in the seed-cane.

Both writes that "he has kept the pest under control in Queensland by sending boys with sharp pocket knives along the rows of cane. The boys spotted the dead or dying shoots and cut them off as close

as possible to the parent cutting. They then opened the shoot and destroyed the fat grub. In some cases, however, the grub had migrated to a fresh shoot which as yet did not show any sign of decay and thus escaped." Roth adds that "while dirty fields were being destroyed wholesale by the grub, clean fields were not infected to any such extent."

A very striking instance in which the moth-borer (or a very closely allied species) was successfully dealt with came under the notice of Kew from the Island of Teneriffe.

In the South-western corner of this island a very large sugar estate has been established and is now under the management of Mr. Richard Tonge of the Icod and Dauté Estate Company. On this estate the canes were very severally attacked by moth-borer, which was believed also to attack the maize crops of the island. The injuries to the sugar-canes were becoming yearly more and more serious. Mr. Tonge was in despair. He carefully studied the habits of the insects and then organised a system of treatment which was steadily pursued for two years. Every person engaged on the estate was taught to recognise at a glance the successive stages of the insect, viz., the grub, the chrysalis, and the mature insect. A small sum was offered for these and payment was made at the close of each day. During one month (February, 1893) there were destroyed 46,884 insects in various stages. During the rest of the year, the numbers were not so large, but the record kept of them shows that 9,640 grubs were cut out of standing canes, 5,022 were destroyed in the chrysalis stage, and 1,144 moths were caught on the wing. By judicious management and personal influence, Mr. Tonge has so thoroughly enlisted the interest of the workpeople that the moth-borer is becoming less and less plentiful. Its practical extermination on this estate is now only a question of time. The period during which the canes are growing appears to be the most critical time. Women and children are then kept regularly employed in cutting out any canes attacked by the moth-borer, and the grubs are destroyed in their burrows. This is regarded as the most effective plan. It is believed that if this plan alone were regularly pursued in the West Indies for two or three seasons, the injuries would be reduced within comparatively small dimensions.

As regards other means for destroying the moth-borer, Mr. Barber, in his letter already cited has added the following interesting points, which deserve consideration. These do not, however, show that the planter should relax his efforts to cut out the grubs in the standing canes. Nothing can do away with the necessity for this. Mr. Barber's remarks exhibit a careful study of the habits of the insect, and draw particular attention to the need for adopting only such remedies as are suited to local circumstances. Countries situated in the tropics where there is no winter's rest for the canes, obviously require a different treatment from that found suitable in the Southern United States and others where canes are only growing during about seven or eight months in the year. In these respects the remedies suggested in the extract from the Indian Museum notes require some modification.

Mr. Barber remarked, in his Report to the Government, of April 1894:—

"The question of burning has, I believe, been much obscured by the

practice in other sugar-growing countries. In the United States there is a winter, the moth-borer hibernating as a grub in the cane; and the burning of the stubble and the dead canes will probably be of service. In Mauritius the moth-borer is credited with spinning a loose cocoon in the trash, and burning the trash will probably be very effective in destroying it. This is quite sufficient to determine the Mauritius borer as different from ours. I have not at present met with any stage of our borer in the trash; it changes from the grub to moth in the furrows in the cane.

"I recommend a study of parasites of the moth-borer. At present a fungus, attacking it in its burrows, does us good service. In one case I detected 13 dead grubs in three Caledonian Queen canes. These were all victims of an undetermined fungus which 'mummifies' the grubs.

"I have not at present succeeded in obtaining the ripe spores for trials in inoculation.

"I have evidence that the vast majority of moth-borer eggs are destroyed by a small parasitic fly. Some of the eggs turn yellow and addled; these probably were unfertilised. Others are left transparent and empty; from these the grubs have escaped. The great majority, perhaps *great* because of their conspicuousness, turn black, and when punctured show a much smaller and more regular hole than the minute grub makes. These I regarded as parasitised. I laid the suspected specimens of blackened eggs before Mr. Hubbard, the entomologist in the United States Department of Agriculture, who is now visiting Montserrat, and he at once recognised the presence of a parasite belonging to a well-known class of egg-eaters. When I detailed the numbers of eggs laid by the moth-borer, and the great majority of blackened ones, he remarked, 'Without this fly you could not grow a cane in these islands.'

The following papers are published in continuation of previous correspondence:—

ROYAL GARDENS, KEW, TO COLONIAL OFFICE.

Royal Gardens, Kew June 5th, 1894.

SIR,

I have the honour to acknowledge the receipt of your letter with enclosures of May 8th and June 2nd on the subject of the disease now affecting the sugar-cane in the West Indies.

2. The history of the matter is briefly this:—

In a letter to the Colonial Office, April 5th, 1893, I pointed out the appearance of the disease in the West Indies, now generally spoken of as "Rind-disease." I stated that it was due to a fungus to which the name *Trichosphaeria* has been given; that the fungus possessed different reproductive phases which had been mistaken for distinct fungi; that it was a very destructive parasite which can effect a lodgment on the young leaves of the sugar-cane but not on the old ones; and finally, that no practical remedy can be suggested to check the progress of the disease beyond the "cutting out" and the careful destruction by burning of every diseased cane. In a further letter, of March 12th last, I stated my opinion that the *Trichosphaeria* had made its appearance quite recently in the West Indies, and I had little doubt that it had been introduced from the Old World.

In another letter of November 3rd, 1893, I informed the Colonial

Office that a further disease, which may be distinguished as "Root-disease," existed in the West Indies; that it was identical with one which existed in Java, where it had been ascertained to be due to a fungus to which the name of *Colletotrichum* had been given. The opinion was expressed that "if perfectly healthy and uninfected canes were only used for "propagation," the disease would not be found to give much trouble." As will be seen from what follows there is positive evidence that at any rate at St. Vincent this precaution is neglected.

3. The specimens of diseased canes obtained by Mr. Bovell in St. Vincent, and referred to in Colonel Sandwith's despatch of May last, have reached Kew, and have been carefully examined. I enclose a copy of the report of the member of our staff to whom I entrusted their examination.

It is evident from these specimens that canes infected with rind fungus are used for propagation. It further appears that when this was the case the resulting plants are attacked by root-disease. This fact points to the conclusion that the root-disease and the rind-disease are really due to one and the same organism, and that the *Colletotrichum* is only another phase of the polymorphic *Trichosphaeria*. This was, indeed, suggested by Mr. C. A. Barber, the Superintendent of Agriculture in the Leeward Islands, in a private letter, December 1, 1893, as the result of his observations made by permission of the Secretary of State in Barbados. But the evidence was not deemed at the time conclusive. The possible identity of the two diseases is still a matter under investigation at Kew. But assuming, as seems probable, that it is well founded it obviously very much simplifies the problem.

4. The remaining contents of the papers call for little remark as far as Kew is concerned. I may, however, be permitted to say that it seems to me a matter for regret that they exhibit a greater inclination to discuss the situation than to take prompt action. I see nothing to modify in the demi-official letter of March 19 last, which, at his request, I addressed to the Governor of Barbados.

5. With regard to compensation, I may point out that I had in view the circumstances of Barbados, which is, I understand, virtually dependent on sugar cultivation. My suggestion was not intended to apply to other colonies where that condition does not obtain.

6. I am not prepared to use any further arguments than those I have already adduced on the absolute necessity of destroying diseased canes by burning. If the sugar-planters will not wage war in the only effective way on the enemies of the sugar-cane, they can only have themselves to blame for the consequences. Mr. Barber urges against burning in Antigua that "the whole atmosphere is saturated with the spores." Even if true, this is no argument against attempting to cut off the supply. No pestilence would ever be checked if mankind simply folded its hands in resignation. It is quite evident that in Antigua at any rate no intelligent pains are taken to combat the enemies of the sugar-cane. It is quite certain that the moth-borer can be checked by persistent effort. And as to the shot-borer, I may quote the opinion of Prof. Riley, the well-known entomologist of the United States Department of Agriculture, who, writing to the Trinidad Committee, said:—
 "You are perfectly correct in tracing the increase of the shot-borer to the discontinuance of the burning of the bagasse (as we call it in this

"country), and it seems probable that the resumption of this custom will greatly decrease the number of these beetles."

I may, however, remark that a general conflagration, as assumed by Mr. Barber, is not absolutely necessary. Careful cutting out of diseased canes should go on continually during the growing season. A general burning should only be resorted to in extreme cases.

7. Finally, I must add that there is not the faintest ground for supposing that the disease has in any way emanated from the botanical stations.

I am, &c.,

(Signed) W. T. THISELTON-DYER.

Edward Wingfield, Esq., C.B.,

Colonial Office, Downing Street, S.W.

P.S.—Referring again to your letter of June 2, I observe that a definite opinion is requested as to the recommendations of the committee appointed by the Planters' Club in St. Vincent. A careful consideration leads me to the opinion that these are unexceptionable and altogether admirable. They will not merely effect all that is possible against the fungoid disease, but must also tend to bring the moth-borer under control. It would be extremely desirable that similar steps should be adopted in Antigua and Barbados.

I may add, as an illustration of what can be effected by vigorous and energetic action, that the sugar-industry in the Canaries was menaced by extinction by the moth-borer. Mr. Morris, the assistant director, spent some time in the islands last year, and informs me that by intelligent and energetic action the moth-borer has been completely brought under control in the space of three years.

W. T. T. D.

(Enclosure.)

ROOT-DISEASE OF SUGAR-CANE, ST. VINCENT.

The disease is caused by the fungus called *Colletotrichum falcatum*, Went. The mature conidia of this fungus are very abundant in the decayed portions of the canes, hence all such should be burnt to prevent further extension of the disease.

The material forwarded furnishes a clue which may lead to important results in connection with the disease. In one of the "stools" sent the portion of cane used for its propagation is badly infested with *Trichosporia sacchari*, the fruit of the *Melanconium* stage being abundantly developed. In this same specimen the hyphæ of the *Trichosporia* can be traced from the old portion into the new canes growing from it. The new canes and their rootlets are attacked by the *Colletotrichum*, which from the evidence at hand, appears to be nothing more than a condition of the *Trichosporia*, modified by being more or less buried in the ground. The necessary cultures for the verification or otherwise of this point are now being proceeded with.

G. M.

19th May, 1894.

ONION CULTIVATION IN EGYPT.

The onion crop of the valley of the Nile is of great importance, and brings an increasing amount of money each year to Egypt, as onions are shipped in immense quantities to England, France and other European countries, and to the United States, where they find a ready

sale at good prices. The quality is stated to be so excellent, that efforts are being made in other countries to grow onions from Egyptian seed. The United States Agent and Consul-General at Cairo says that in all departments of Egyptian agriculture, watering is accomplished by means of irrigation from the Nile, either directly or from canals. The most popular Egyptian onion, known as *Baali*, is grown in yellow soil, sparingly watered while the bulbs are maturing, that they might stand a lengthened sea voyage with little risk of sprouting. There are two stages of cultivation, the first covering the season of the sprouts for transplanting. Towards the end of August or the beginning of September, the land intended for the onion crop is irrigated from the Nile. After letting the water run off, it is left to dry until the first ploughing when the ploughshares penetrate not deeper than four fingers' breadth. All clods of earth are broken up and pulverised, and the land is divided into plots about ten feet square, and stirred lightly with a matlock—the favourite implement of the Egyptian farmer, which is double headed, one side being broad, like an adze, and the other like a pickaxe. The seed is then scattered freely and evenly at the rate of about two bushels to the acre. After sowing, a plank is passed lightly over the soil to cover the seed and bring the plots to the same level. The plots are then irrigated, the islets along the Nile being watered four times, and the raised land six times. The first irrigation takes place immediately after sowing, and the water is completely absorbed; a second, and very light watering is given as soon as the plants appear above ground, and the borders of the plots are sprinkled. If the seed is planted in raised land, manure is applied, but if sown in low ground there is no need of manure; the onions ripen in the first fortnight in October. The second stage covers the period from the transplanted sprouts to the mature onions. Land intended for *Baali* onions is soil of good quality, with no weeds or grass, or yellow land of the same quality, and damp enough to allow the crop to grow and ripen. It is irrigated in September, and it is ploughed three times, the ploughshare penetrating to a depth of about eight inches. After a third, and last, ploughing, the onions are set out in furrows, at a distance of four inches apart. The furrows resemble wheat furrows, and the earth covers the onions in the second furrow. In ploughing the last time, the cultivator plants the bulbs in the furrow; the plough, returning in the second furrow covers them. The stalks, or tops, of the seed onions, emerge from the soil to a height of four fingers' breadth or more. Every 20 days the weeds are pulled out, in order that the onions may be clear and allowed to develop. In the month of April the tops die, and the onions are pulled, and when perfectly dry are packed in coarse sacks and sent to market. *Baali* onions in their second stage are never watered directly. *Miskaoni* onions absorb so much moisture from the frequently irrigated ground in which they grow that they are seldom exported. They are sown in the same way as the *Baali*, that is, the sprouts are used as seed, and any kind of soil can be used. The land is irrigated at the beginning of September, and, after the water has run off, it is left to dry until it can be ploughed. It is ploughed twice, and divided into plots 10 feet square, each furrow being a little over two inches deep and nearly five inches wide. The plants are laid in the furrows, at

distances of four inches, and the water is immediately let in. The second irrigation takes place in 12 days, and the third in 24 days; after this, the soil is watered every eight days; the ground is then left 10 days without watering, and the onions ripen and are unearthed; they are known to be mature when the tops become dry. The cultivator plants the sprouts in the furrows, head downwards, burying them to the depth of four fingers' breadth.—[*Journal of the Society of Arts*].

FORESTRY.

In Bulletin No 45 will be found some notes on Timber Trees. I then advocated the extensive planting of West Indian Cedar, Mahogany, Mahoe, Juniper Cedar, Yacca, &c., for the sake of the valuable timber which they would eventually produce. Whilst still of opinion that this is a subject of great importance in a commercial sense, especially in a country where good timber is scarce, and the imported article expensive, the matter may be viewed in another light, of no less importance to agriculturists, and that is the effect forests have on the temperature and rainfall. Dr. Schlich, Professor of Forestry at the Royal Indian Engineering College, Cooper's Hill, and late Inspector-General of Forests to the Government of India, in his "Manual of Forestry" gives much useful and interesting information bearing on this subject. Speaking of the effect of forests on the moisture of the air he says: "Air can hold only a certain maximum quantity of vapour, which increases and decreases with the temperature. When the maximum has been reached, and more vapour is introduced, a part becomes fluid. The absolute vapour in the air is measured by its tension upon a column of mercury, as represented in a barometer. The proportion of the absolute tension to the maximum tension of vapour, which is possible at a certain temperature and pressure, is called the relative humidity of the air. Although the humidity of the air depends in the first place upon the general distribution of heat and air pressure over the large sheets of water on the earth, which govern the direction and force of the moist air currents, the vegetation of the earth must also affect the degree of humidity, chiefly because it reduces the temperature locally. That effect may be felt in the degree of humidity of the air, the amount of precipitation, the degree of evaporation, and in the feeding of springs and rivers." "That forests can affect precipitations follows from the facts, that forest air is relatively moister than air in the open, and that the trees mechanically affect the movement of the air." "On the whole it may be said, that various physical factors act towards rendering forests excellent condensators of vapour, because they have a lower temperature, a moister air, and break the force of air currents." Speaking of the feeding of springs and rivers he says: "Most of the rain-water falling on a bare slope rushes down into the nearest watercourse in a comparatively short time, thus causing a rapid rise in the level of the stream. Only a comparatively small portion sinks into the ground, so as to become available for the feeding of springs. Of the rain falling over a forest, close on one-fourth is intercepted by the crowns of the trees, and the other three-fourths fall upon a layer of humus, which possesses a great

capacity to absorb water, and to retain it for a time. Part of the water thus absorbed penetrates into the ground and becomes available for the feeding of springs while the remainder gradually finds its way into the nearest stream. In this manner well-preserved forests must have a decided effect upon the sustained feeding of springs, and the moderation of sudden floods in rivers." On protection of the soil he says: "Water rushing down a bare slope possesses a great mechanical power, by means of which it loosens the soil, and carries it down hill. In this way landslips are often caused, ravines are formed, and fertile land, situated at the foot of the ravines, may be covered with silt and rendered valueless. Frequently the *débris* collects in rivers and forms obstructions, which are followed by a diversion of the bed and erosion of fertile lands. The rate at which this process proceeds, depends on the geological formation of the surface; the less binding the soil and the looser the formation, the greater will be the damage. If, on the other hand, such slope is covered with a well-preserved forest, the roots of the trees and the layers of humus keep together and protect the soil against the action of water; besides the crowns intercept and retain, at any rate for a time, a considerable portion of the water. On the whole, a series of obstacles are opposed to the movement of the water, which reduce its velocity and force, or at any rate divide it into numerous small channels. The beneficial effect of tree vegetation in this respect can be observed in most mountain ranges, and especially in the Alps from France to Austria. Wherever, in those parts, extensive deforestations have taken place, the consequence has been the gradual formation of a series of torrents, in all places where the surface did not consist of hard rock; the *débris* brought down has covered more and more fertile land at the base of the torrents, and this evil has grown to such an extent, that not only in France, but also in the other Alpine countries, great efforts are now made to re-forest the denuded areas at a great outlay. When once the evil has been created immediate afforestation is not possible; it must be preceded by the construction of dams, dykes, walls, &c, to steady the soil until the young forest growth has had time to establish itself and once more to lay hold of the surface soil."

"The importance of maintaining a complete cover of vegetation in all such cases was recognised many years ago, so that already in the middle ages so-called "Protection Forests" existed, which the then existing laws protected against devastation."

"Forests protect the soil not only in the hills, but also in lowlands, wherever it consists of so-called moving or shifting sand, along the sea-coast as well as in the interior of countries. The action in this case is due partly to their moderating the force of the air currents, and partly by keeping the soil together through their roots, by the formation of humus and the retention of moisture. In this way the Landes of France have from a dreary waste, been converted into extensive forests intersected by cultivated fields."

"Hygienic effects of forests. Forests in forming a substantial part of the vegetation of the earth, are an important agency for the production of oxygen obtained by the decomposition of carbon dioxide. Direct observations have also shown that forest air (like sea-air) is

much richer in Ozone than the air of open countries, and especially of towns. Prof. Schlich sums up as follows:—

- (1) Forests supply timber, fuel and other forest produce.
- (2) They offer a convenient opportunity for the investment of capital and for enterprise.
- (3) They produce a demand for labour in their management and working, as well as in a variety of industries which depend on forests for their raw material.
- (4) They reduce the temperature of the air and soil to a moderate extent, and render the climate more equable.
- (5) They increase the relative humidity of the air and tend to reduce evaporation.
- (6) They tend to increase the rainfall.
- (7) They help to regulate the water supply, secure a more sustained feeding of springs, tend to reduce violent floods, and render the flow of water in rivers more continuous.
- (8) They assist in preventing landslips, and silting up of rivers and low-lands, and arrest moving sands.
- (9) They reduce the velocity of air currents, protect adjoining fields against cold or dry winds, and afford shelter to cattle, &c.
- (10) They assist in the production of Oxygen and Ozone."

Dr. J. Croumbie Brown in his volume on Forests and Moisture cites several cases in which the destruction of trees had been followed by desiccation; and the planting of trees has been followed by the restoration of humidity. In speaking of Mauritius he says:—

In a history of that Island, embodied my informant believes in Thorton's History of India, the author observes that when we obtained possession of it our countrymen thought it absurd that the beautiful land on the summits and slopes of the mountains should be abandoned to forests and jungle, and so cut them down, upon which the water supply began to fail. Reflection soon taught the authorities the cause of this failure; upon which the hills were again planted with trees, and the rivers and streams resumed their former dimensions.

Mr. Marsh writes:—"The Island of Mauritius lying in the Indian Ocean is about 20° N. L., is less than 40 miles long by about thirty in breadth. Its surface is very irregular, and though it consists, to a considerable extent, of a plateau from 1,200 to 1,500 feet high, there are three mountain peaks ranging from 2,300 to 2,700 feet in height. Hence, though the general climatic influences are everywhere substantially the same, there is room for a great variety of exposures and of other purely local conditions. It is said that the difference of temperature between the highest and lowest stations does not exceed eight degrees F., while, according to observations at thirty-five stations, the rainfall in 1872 varied from thirty-three inches at Gros Cailloux to one hundred and forty-six inches at Cluny. *Nature*, September 24, 1874. This enormous difference in measurement is too great to be explained by possible errors of observation or other accidental circumstances, and we must suppose there are, in different parts of this small island, great differences in the actual precipitation, but still much of this variation must be due to causes whose range of influence is extremely limited."

Mr. Meldrum, Director of the Mauritius Observatory, read a paper before the Scottish Meteorological Society in July, 1866. In this he stated that for some years before there had been severe droughts in the island, and recently there had been severe outbreaks of fever, which had carried off one-tenth of the population. A careful analysis of Meteorological observations that had been made showed that from 1861 to 1866 there had been a great diminution in the rainfall. So far as could be discovered the rainfall was less than during any similar period since the island was discovered. This could only be explained by the cutting down of large forests in the interior, no less than 70,000 acres having been denuded of trees during the ten years from 1852 to 1862. Mr. Meldrum concluded by saying that the calamities which had so seriously affected the people of the Mauritius seemed to be self-inflicted; and that the proper remedy was to restore the forests of which the once salubrious and beautiful island had been deprived. And in a communication published in the Journal of the English Meteorological Society for that year there is given additional information on the subject. In this he states: "That the rainfall in that island during the five years 1862-66 was considerably less than during any previous five years of the whole period since 1853;"—"that during the first five years, from 1853-57, the relative humidity of the air was 72.1, whilst during the last five years, 1862-66 it was only 68.2;"—"that the vapour pressure, which in the earlier of these quinquennials was .657, had fallen during the latter given quinquennial to .638."

Notwithstanding these facts, he says:—"In no former year of the period of fourteen years did such floods occur as in 1861, and 1866, or such severe droughts as in 1865 and 1866," and to account for these facts he says:—"That the decrease of rainfall humidity, and vapour pressure, and the occurrence of floods and droughts, may in some measure be due to the cutting down of the forests, which commenced on an extensive scale about 1852, was vigorously carried on till 1862, and is being still prosecuted, though to a small extent."

One chief cause of the cutting down of the forests in Mauritius, Mr. Meldrum states thus:—"Proprietors of forests in high and remote parts of the island, where the climate was as yet too damp and rainy for sugar-cane, engaged in the work because they believed that their land would thereby become more fit for such crops; for it was very well known that the climate became drier in proportion as the forests were cut down. Upon the whole, I think, at least 70,000 acres, or about one-sixth of the entire area of the island, have been denuded of forests since 1852, and that, too, on the central and elevated parts of the island, at or near the sources of the rivers."

He points out how, by the lowering of lakes, and the complete desiccation of others, malaria resulted, and a deadly epidemic. And the remedy which he suggests is, "to restore, as far as practicable certain portions of the forests of which this once salubrious and beautiful island has been deprived."

In 1871, a report was issued by Dr. H. Rogers, of Mauritius, "on the effects of the cutting down of forests on the climate and health of Mauritius." This Report I have not seen; but in a lecture on Forest Culture in its relation to industrial pursuits, delivered in Melbourne

on the 22nd June, of that year, by Baron von Müeller, Government Botanist in Victoria, there was given the following resumé of its contents, with the remarks which follow: So late as 1864 the island was resorted to by invalids from India as the "pearl" of the Indian Ocean—it being then one mass of verdure. But when the forests were cleared, to gain space for sugar cultivation; the rainfall diminished; the rivers dwindled down to muddy streams; the water became stagnant in cracks, crevices and natural hollows, while the equable temperature of the island entirely changed; drought was experienced, and thunder showers were rarely any longer witnessed. The lagoons, marshes, and swamps, along the sea-board were no longer filled with water, but gave off noxious gases, while the river waters became impure from various refuse. After a violent inundation in February 1865, followed by a period of drought, fever of a low type set in. Against this the remedies employed in ordinary febrile cases proved utterly valueless. From the waterless sides of the lagoons pestilential malaria arose. Exposed to this the labourers fell on the field, and in some cases died within a few hours. Scarcity of food among the destitute classes, and inadequate sewage arrangements, predisposed also to the dreadful effect of the time. It is alleged, and maintained, that marshes should either be drained out completely, or kept constantly submerged. And Dr. Rogers insists that, for sanitary reasons alone, the plateaux and high lands of Mauritius must be replanted with trees.

To what extent this may have been done, and with what results, remain to be seen.

In Chamber's Journal it was mentioned in the beginning of 1875, apparently on the authority of the transactions of the Royal Society of the Mauritius, that with a view to check the increasing dryness of the climate 800,000 trees had been planted and 150,000 seed holes prepared on barren mountain slopes and other waste places. And we have the following statement in regard to what appears to have been a prior application of the remedies proposed:—"The hills were again planted with trees, and the rivers and streams resumed their former dimensions."

Reference is made to the Island of Ascension by Boussingault in his work entitled, "*Economic Rurale considérée dans ses Rapports avec la Chimie la Physique et la Mineralogie*," in a passage which has been cited, in which he says:—"In the Island of Ascension there was an excellent spring situated at the foot of a mountain originally covered with wood. This spring became scanty, and at last dried up, after the trees which covered the mountains had been felled. The loss of this spring was ascribed, and rightly so, to the cutting down of the timber. The mountain was therefore replanted, and a few years afterwards the spring reappeared by degrees, and by and by flowed with its former abundance."

Riding through the hills of Jamaica, up to say 5,000 feet altitude, one is struck by the barrenness which prevails; the scarcity of timber, or other trees, and the consequent parched appearance of the hill-sides where nothing but scrub and coarse grasses grow. In wet weather rushing torrents abound, but after a few weeks of dry weather in the same localities, it is often impossible to obtain water. Many of the hill-sides, even at the higher elevations, have been so denuded of forest growth and shelter belts, and are so exposed to the full rays of

the sun as to be unfit for cultivation. And this work of denudation goes on from year to year, till eventually there will be no woodland left that can possibly be cleared and turned into provision grounds, which are maintained only for so long as the virgin soil yields a good return, and are then abandoned to rank bush, and a fresh piece of forest or woodland is ruthlessly destroyed; the hitherto "never failing" springs diminish in volume, and frequently in dry weather are quite dry, the atmosphere becomes hot and dry, vegetation languishes, the moisture-loving plants perish and in the end give place, as already mentioned, to scrub and coarse grasses.

An illustration of the manner in which trees intercept and precipitate moisture has several times lately come under my observation. In the hills we are often, especially in the afternoon, enshrouded in mist, more or less dense. A few weeks ago, during one of these mists, my notice was attracted to a continual dripping from the foliage of some, tall trees of Eucalyptus as if a shower of light rain had fallen on them although there had been no rain. On examination I found that the mist, which was moving along at a fair rate, there being a light wind at the time, was intercepted by the foliage of the trees, condensed and precipitated in large drops, and in about a quarter of an hour the ground underneath the trees was as wet as if it had been sprinkled with a garden hose, although the ground away from the trees was as "dry as dust."

I may add that plants of timber trees are distributed free to responsible persons, from the Public Gardens. Applicants must, however, bear the cost of packing and transport. At the present time there is a large number of West Indian Cedar and Mahogany plants available for distribution. Applications for these plants should be addressed to the Director of Public Gardens and Plantations, Gordon Town P.O.

W. HARRIS.

AGRICULTURAL PRODUCTS OF NICARAGUA.

Attention has been called in the *BULLETIN* to the extension of coffee cultivation in Central America. *THE JOURNAL OF THE SOCIETY OF ARTS* says that the principal agricultural wealth of Nicaragua lies in its coffee plantations, and although this industry is still in its infancy every year witnesses its augmentation, and the Bureau of the South American Republics states that the time is near at hand when Nicaraguan coffee will take the prominent position to which it is chiefly entitled. There are millions of acres in the country that are especially adapted to its cultivation. Coffee grows well almost everywhere in Nicaragua, but best in the mountainous districts. The production at a height of from 200 to 2,000 feet above the level of the sea is generally at the rate of $\frac{1}{2}$ lb., and in some cases 1 lb. per tree. At an elevation of 2,000 or 3,000 feet, the production fluctuates between 1, 2, 3, 4, and even 5 lbs. per tree, according to the quality of the ground. At a higher altitude the production diminishes gradually until it ceases entirely on account of the cold temperature. There are, in Nicaragua, certain coffee regions offering the best possible advantages for the cultivation of this plant. They are to be found in the departments of Managua, Carazo, Matagalpa, Chontales, Jinotega, and on the slopes of the hills and volcanoes of the other departments.

For some years past, in consequence of the high price of coffee, a great impulse has been given to its production. According to the public records 24,598 manzanas of public land were taken up in 1890, of which 16,740 manzanas were intended for the cultivation of coffee. Of these, 8,491 manzanas are in the department of Matagalpa, and 4,101 in that of Managua. In the department of Matagalpa alone, there are at the present time about 2,000,000 young trees under cultivation, which will begin to yield in about a year's time. The construction of the Nicaragua Canal, and of railroads that are projected to the Atlantic coast will, it is expected, give an immense impetus to coffee-growing. The production of India-rubber is an important industry in Nicaragua, but it is annually decreasing from the reckless slaughter of the trees. India-rubber, called in South America *caucho*, and in Central America *hule*, is obtained in South America from the *Siphonia elastica*, a tree growing to 50 or 60 feet in height. The collectors of rubber, called *huleros*, employ several methods to obtain it. In some cases the trees are felled, and channels cut round the trunk, from which the sap or milk flows; in others the tree is left standing, and two or three vertical channels, according to the size of the tree, are cut through the bark from top to base; then numerous oblique channels are cut connecting with the vertical ones. To do this work, the *huleros* improvise ladders from the vines and creepers, which everywhere abound in the tropical forests. In all the lower regions of Nicaragua, particularly in those extending towards the Caribbean coast, there are large tracts of land suitable for growing rubber trees and it is said that their cultivation would prove very profitable to anyone who could afford to wait for a return from capital invested until the trees reach maturity, which is from seven to ten years. Bananas are largely grown, and when the bars to the mouths of the rivers are improved, and when the inter-oceanic canal and railways afford means of transportation, this fruit will become a still more prominent feature in the exports from Nicaragua, and the large profits yielded to the producers will stimulate agricultural operations on thousands of acres of fertile land now practically uncultivated. There is a variety of the banana family, the plantain whose production in Nicaragua need only be limited by the demand for it, which must become immense when its merits are appreciated. In Nicaragua this fruit is boiled, stewed, baked, roasted in the ashes, fried, dried and ground into flour, cooked in the skin or out of it, green or ripe, and produces much more nutriment per acre than is yielded by wheat, maize or potatoes. Cacao is grown in Nicaragua, and is sold with advantage in the markets of the world. The sugar-cane grows with extraordinary luxuriance. The canes are soft, and contain no more woody substance or less saccharine matter than those produced in the East or West Indies, where their duration is wonderful. A great deal of the sugar manufactured in Nicaragua is of a coarse brown quality, the juice being merely boiled until it crystallizes, without being cleared of the molasses. In this crude state it is poured into moulds forming small cakes, which are sold to the poorer classes. A very large quantity of the sugar-cane is used in the manufacture of a species of rum called *aguardiente*. The bulk of the sugar produced in the Republic is manufactured in the district of Jinotepe, in the Department of Granada, where, although very primitive and imperfect

methods are employed, it is stated that in the year 1890 the production amounted to about 2,500,000 pounds. The total production for 1890 exceeded 3,500,000 pounds. Cotton is indigenous in Nicaragua, and the finest quality can be produced in vast quantities. Instead of being an annual plant, as in the United States, the cotton plant is perennial in Nicaragua, and growing much larger, yields double the quantity that it does in the most favoured locality in the United States. Maize, rice, and tobacco are abundantly grown. Indigo and cochineal were formerly produced in large quantities, but as they have been superseded by the introduction of mineral dyes, the cultivation of these articles has almost entirely ceased. The *yuca*, the yam, (*yam*), and the sweet potato are the principal farinaceous roots that are extensively cultivated. The *yuca* is not only useful for food, but valuable from an industrial point of view, as the starch it yields could readily be made an extensive article of commerce. The breadfruit grows to perfection in Nicaragua. The tree consists of a massive trunk with dark green leaves, and it begins to bear about three years after planting. It yields two crops in the year, one lasting through March and April, and the other from August to October. Each fruit weighs from six to ten pounds, and is said to have a delicious taste when fried or boiled. The coconut tree is abundant, and on the Caribbean coast it is an important article of commerce, although no efforts have been made to utilise the fibre of the husk. *Frijoles*, the brown beans that form such a prominent article of diet throughout Spanish America, are produced abundantly in all parts of the Republic, while all other tropical fruits such as oranges, lemons, limes, citrons, pineapples, guavas, mangoes, &c., grow in great profusion. The vegetables of the temperate zone grow luxuriously in the more elevated districts.

FORESTRY.

THE PRESIDENTIAL ADDRESS IN THE SECTION OF BIOLOGY AT THE BRITISH ASSOCIATION MEETING IN OXFORD, AUGUST, 1894, BY DR. I. BAYLEY BALFOUR, REGIUS PROFESSOR OF BOTANY IN THE UNIVERSITY OF EDINBURGH.*

Forestry, is a branch of applied science to which, in the British Islands, but little attention has been given by any class of the com-

* This subject is of the greatest importance in Jamaica on those general principles so admirably summarised in the sixth paragraph. But the seventh paragraph is not applicable to a country like Jamaica, where there are large forest areas, and where 40 inches of rain may fall in a few days instead of being spread over the greater part of a year.

While these general principles have been brought forward very many times in the Annual Reports and the *Bulletins* of this Department for many years, and in the special Report on the Forest of Jamaica by an Indian Forester, Mr. Hooper,—it has not been neglected to point out that a period of general "timber famine" is fast approaching, and that there is therefore a duty, which cannot be avoided, incumbent on the present generation to commence planting to provide against that contingency. Prof. Balfour puts this view of the subject clearly and forcibly in paragraphs 9, 10, and 11.

Although much of this Address bears reference only to the British Isles, there are nevertheless so many suggestions scattered through it that are valuable also to owners of land in Jamaica, that it seemed better to give the whole in full, than merely to make a few extracts.

The Government is already helping in this important subject by the distribution through the Botanical Gardens of young seedling trees at the cost only of packing and carriage.—[EDITOR].

munity. By scientific men it has been practically ignored. Yet it is a division of Rural Economy which ought to be the basis of a large national industry.

2. There are no intrinsic circumstances in the country to prevent our growing trees as a profitable crop for timber as well as our neighbours. On the contrary, Great Britain is specially well adapted for tree-growing. We have woodlands of fine trees, grown after traditional rule-of-thumb methods, abundant in many districts. The beauty of an English landscape lies in its trees and its pastures. Nowhere in the world, probably, are to be found finer specimens of tree-growth. As arboriculturists we are unrivalled. But the growing of trees for effect and in plantations is a very different matter from their cultivation on scientific principles, for the purpose of yielding profitable crops. This is *silviculture*. The guiding lines of the two methods of culture are by no means the same—nay, they may be opposed; and it is the *silvicultural* aspect of the science of forestry which has hitherto been neglected in this country. The recognition of this is no new thing. But within recent years it has attracted considerable public attention, as the importance of wood cultivation in our national life has been more realised; and although various proposals have been put forward, and some little effort made for the purpose of remedying the admittedly unsatisfactory state of forestry practice, there has been so far no great result. I attribute this in great measure to the apathy of scientific men, especially botanists, and I am convinced that until they devote attention to forestry the great issues involved in it will not be rightly appreciated in the country.

3. It is not the first time the subject has been before this Section. I find that in 1885, at the Aberdeen meeting, a committee was appointed by it to consider "whether the condition of our forests and woodlands might not be improved by the establishment of a forest-school." The good intention of the promoters was not fulfilled, however. The committee did not meet.

4. In the first instance, let me briefly refer to the national economic features of forests as they affect us.

5. There are two aspects from which forests are of importance to a country—firstly, as a source of timber and fuel; secondly, on account of their hygienic and climatic influences.

6. With regard to the latter, it is a popular notion that trees exercise considerable influence upon the atmospheric conditions, but it is only within recent years, and as the result of long experimental research in Switzerland, France, Austria, Germany, and other areas where forestry is practised at a high level of excellence, and also in the United States, that any sufficient data have been forthcoming to form a basis of scientific conclusion upon so important a matter. Although many points are still far from clear, the evidence goes to show that the direct influence of tree-growth upon climate is no mere superstition. Stated in the most general terms, it is proved that forests improve the soil drainage, and thereby modify miasmatic conditions; whilst, like all green plants, trees exercise, through the process of carbon-assimilation, a purifying effect upon the air, the existence of the increased quantity of ozone often claimed for the vicinity of forests

is not yet established; by opposing obstacles to air currents, forests prevent the dissemination of dust particles with their contingent germs; they reduce the extremes of temperature of the air; they increase the relative humidity of the air and the precipitation in rainfall, and they protect and control the waterflow from the soil.

7. To us these effects do not appeal with the same force that they do in continental areas. Our insular and geographical position renders us in a measure independent of them. The data for these continental results, it must be remembered, are derived from large forest areas such as do not exist here. For this country I know of no experimental evidence on the subject. As, however, the effects of forest influence are felt mainly in local modification of climatic conditions, we are not justified in regarding the conclusions that have been reached as inapplicable to Britain. No little interest attaches, therefore, to a statement based upon these continental observations to which Dr. Nisbet has recently done well to call attention—that, “where the rainfall is over forty inches it is undesirable to increase the forest area.” The significance of this dictum, if it be established, to Britain, dependent so largely upon her agriculture, is evident. Wet years, unfavourable to farm crops, are, under existing conditions, more numerous than favourable dry ones, and any extensive tree-planting in agricultural areas might therefore prove disastrous. But I may here emphasise the point that, whilst for the growing of specimen trees we may agree with Evelyn when he says, “If I were to make choice of the place or the tree, it should be such as grows in the best cow-pasture, or upland meadow, where the mould is rich and sweet,” yet the harvest which scientific silviculture reaps comes from land unsuited to agriculture, which would otherwise lie barren and waste, and therefore schemes for the afforestation of such areas in non-agricultural districts need not be prejudiced by the prospect of an increased local rainfall. At the same time we must not fail to learn the obvious lesson that afforestation is not, as some suppose, a simple matter of employment of labour, but that it involves the consideration of weighty scientific problems.

* 8. Forests, as a source of fuel, have not the direct importance to this country, rich as it is in coal-supply, that they have in States less favoured, but their economic importance to us as a source of timber needs no comment. There are no means available through which to estimate the annual output of timber from our plantations, but indirectly we can gauge the insufficiency of our woodlands to supply the timber necessities of the country by reference to the returns showing the amount and value of forest produce annually imported. This has been steadily increasing until in 1893 its value exceeded eighteen million pounds. Of course a considerable proportion of the material thus imported could not in any circumstances be produced in Britain. But, after allowing a liberal discount for these, there remains a large bill which we pay for produce, no small portion of which could be furnished at home. No one would suggest that in the limited and densely populated area of great Britain timber trees of kinds suiting our climate could be grown sufficient to supply all our demands; that would be impossible. But few would venture to deny that we could do very

much better for ourselves than we do, and that our labour payments abroad might be materially reduced. It is admitted that well-grown home timber is, of its kind, equal to, if not superior in quality to that which is imported; it is surely, then, legitimate to expect that a large supply of well-grown timber would enable us to hold the market to a much larger extent than is presently the case, and that we might be very much less dependent than we are upon the surplus timber of other nations.

9. The importance of this to the country is increased by the consideration of the continued appreciation of timber. There is abundant evidence forthcoming to indicate that the present rate of timber consumption of the world is in excess of the present reproduction in the forests of the great timber supplying countries, and with the persistence of existing conditions we would appear to be within measurable distance of timber famine. Experience, too, teaches that we may expect not a diminution but rather an increase in consumption. No doubt as civilization advances, the discoveries of science will as they have done in the past, enable us to substitute in many ways for the naturally produced wood, other substances prepared by manufacture; but this saving in some directions has been, and will probably continue to be, counterbalanced by greater utilisation in others—witness, for example, the enormous development within recent years of the wood-pulp industry abroad, and consider the prospect opened up by the manufacture of wood silk which is now being begun in Britain.

10. That the possibility of forest exhaustion is no chimera should be evident to any one conversant with current timber literature. Taking North Europe, for instance:—In Norway, “raw timber is yearly becoming more expensive and more difficult to obtain.” To Sweden, “pitch pine long beams are taken from America, suitable ones of sufficient size and quality being unobtainable now in Sweden.” In Scandinavia, the virgin forests, “excepting such as are specially reserved by the Government in the districts where mills are situated, are almost exhausted.” In Russia, the Riga “supply of oak is exhausted.” These sentences, culled within the past few weeks from trade journals, show that this is a more pertinent question than some would suppose. In Sweden, which, it is remarkable, is actually importing logs from America, the situation is regarded as so serious that proposals are on foot for the imposition of a tax upon exported timber for the purpose of raising a fund for replanting denuded areas. But it is not only in North European countries that there are signs of the giving out of timber forests. As they fail the demand upon Canadian and American stocks increases, and when we look at these Canada “shows signs of beginning to find it hard to continue her voluminous exports to Europe, and at the same time send sufficient supplies to the United States.” But the most striking evidence is that furnished by the chief of the United States department of forestry, in his official report for the year 1892, in which he says: “While there are still enormous quantities of virgin timber standing, the supply is not inexhaustible. Even were we to assume on every acre a stand of 10,000 feet B.M. of saw timber—a most extravagant average—we would, with our present consumption, have hardly one hundred years of supply in sight,

the time it takes to grow a tree to a satisfactory log size. Certain kinds of supplies are beginning to give out. Even the white pine resources, which a few years ago seemed so great that to attempt an accurate estimate of them was deemed too difficult an undertaking, have since then, become reduced to such small proportion that the end of the whole supply in both Canada and the United States is now plainly in view."

11. It must be owned that there are those who do not regard the suggestion of forest exhaustion as a serious one. They argue that the prophecy is no new one, and yet we are none the worse off than we have been; that failing supply from one source it has always been possible to tap another, and so it will probably continue; and then the period when exhaustion is likely to take place is so far off, there is ample time for the growth of new forests to replace those being cut. No doubt there is time. But this is just the kernel of the whole forestry question. With proper conservancy of forest areas, the application of scientific principles to the recuperation of areas recklessly denuded, and the afforestation of barren and waste lands, timber sufficient to meet a greater demand than is now made could be produced. This is the aim of scientific forestry, and it is to secure this that those who have given attention to the subject are working, conceiving it to be a duty of this generation to hand down to its successors a heritage no less valuable than that which it received.

12. With an acreage of wooded land amounting to only 4 per cent of their total area, Great Britain and Ireland possess a smaller proportion so covered than any other European country. Denmark comes near with only about 5 per cent., in France the percentage rises to 15, in Norway and Germany to 25, in Austria-Hungary to 30, whilst in Sweden the amount is over 40 per cent. The United States is estimated to have about 25 per cent. These figures do not, however, give a fair basis of comparison of the amount of timber area in Great Britain with other countries, inasmuch as in the continental lands the bulk of the woodlands is true forest, whilst a large part of the area included in the British return is merely pleasure ground, and another large portion is only plantation; of real forest the area is extremely limited. It is not surprising, then, that we are not able to furnish ourselves with an adequate supply of timber. But although there is so little land under wood, there are thousands of acres unsuited for any other crop, and these for reasons I have already indicated, it is desirable to have planted. How to have this accomplished, and how to secure that woodlands already existing shall be tended so as to produce a maximum result, giving a profitable return, are the problems we wish to see solved.

13. It will conduce to appreciation of the question if I briefly discuss the causes which have been active in developing the present condition of woodlands in Britain, and in bringing about the disparity between it and other countries in respect of woodland area.

14. State ownership of continental forests will probably occur to most people as the reason for the difference in area just pointed out. This is true with, however, some qualification. In consequence of the circumstances of their situation continental States have been compelled to recognise the national economic importance of forests. This they have done, not so much by the creation of State ownership in vast forests as

by the organisation of a State department of forestry and a State system of forestry education. It is altogether a mistake to suppose as is often the case, that the whole or even a large part of the forests on the continent belong to the respective States. The amount of State-owned forest is surprisingly small. Fernow gives it in Germany as about 33 per cent. of the whole forest area; in Scandinavia 15 to 20 per cent., in France some 10 per cent., in Switzerland 4 per cent., whilst in Italy it is not 2 per cent. The bulk of the forest is in the hands of private owners or corporate bodies, subject, though apparently not always, to some control or limitation by the State. But the example of the States in the management of their own woods, their readiness to give advice through their officials, and the education which is carefully provided for those concerned in forestry work, have resulted in those privately-owned forests being as well managed as those of the State. It is important to make clear this distinction, because it shows that a State system of conservancy and supervision of forestry is quite compatible with large private ownership in forests, and that efficient silviculture upon a large scale is not inseparable from State ownership.

15. But some one may say, "We, too, have State forests!" Yes, but it is almost absurd to mention them in the same sentence with those of the continent for any part they play at present in connection with forestry in Britain. The nine thousand acres at Windsor are mainly covered with specimen trees. Of the twenty-five thousand acres in the Forest of Dean, a portion is supposed to be cultivated for a profitable crop, but appears to result in an annual deficit. The New Forest, with its sixty-three thousand acres of soil-area, affords us one of the most interesting object-lessons, showing the triumph of sentiment over common-sense, that the country affords. Its history is well enough known, and I need only remind you that Parliament has decreed the major part of it to persist as a barren waste, whilst in the remainder, which is covered with trees, the practice of forestry is prohibited, so that slowly the whole is going to wreck and ruin. This illustrates the value to us of State forests! In the days of the "wooden walls" the dockyards obtained valuable timber from them, but now their large area is, one may say of no State service whatever as forest, if one excepts a small portion of Windsor Forest recently attached for instruction purposes to Cooper's Hill College. There can be no question that if the State had set an example of scientific forestry in even a portion of these areas, the practice of silviculture now throughout the country would have been very different.

16. I need not dwell on the fact that the conditions of land tenure in the country have exercised an important influence upon the extent of wood-planting in the country; and they must always do so. "The oak scorns to grow except on free land" is a saw that sums up pithily the relationship between land-laws and woodlands in England. Copyholders could hardly be expected to plant much timber when the lord of the manor claimed the crop: and I believe it is possible in some counties to trace the boundaries of copyholds by the entire absence of trees on one side of a line and the luxuriant growth on the opposite side. The intricacies of entail and the fact that life-renters had themselves to bear

the expense of planting, except where necessary for shelter, without prospect of seeing a return for the outlay, must have operated prejudicially to an increase in woodlands. Happily since 1882 in England, and by an Act of last year for Scotland, the last-mentioned restriction upon tree planting is removed.

17. Nor shall I pause over the question of game, which has been at once the origin and the destruction of forests in Britain. Not that it is an unimportant element. But the instinctive love of sport in the British race is proof against all argument of utility, and the needs of sport will always be a barrier, as they have been in the past, to the planting of large areas well adapted for timber growing. It cannot well be otherwise. Landowners can hardly be expected to forego large and immediate game rents for what appear the long-delayed, even though possibly greater, profits of timber cultivation. In this case the inevitable must be accepted. Nevertheless, there are large areas, the game-rent of which is infinitesimal for their acreage, which might be planted.

18. The most potent factors in bringing about the present condition of our woodlands are probably to be looked for in the nature of the crop itself and in the want of appreciation of its character manifested by landowners; in a word, in a want of knowledge of the principles of scientific forestry. Forestry is handicapped as compared with agriculture by the fact that the crop cannot be reaped within the year. The owner who plants and incurs the initial expense of stock, fencing, and perhaps draining, may after some years secure intermediate return from thinnings, but it will rarely happen that he reaps the final yield at maturity of the crop he has sown; it will fall to his successor. It is this planting for posterity that makes demands upon the landowner to which he is unequal. Hence it comes about that woodlands, beyond what may be requisite in the way of cover plantation and for shelter, are often regarded as expensive luxuries, and, in the time of high agricultural values, landowners have even grubbed out trees to make way for annual crops yielding an immediate return. But scientific tree-growing for profit does not consist in the covering of soil-area indiscriminately with trees, without definite system and relation of its part one to the other. Just as the farmer has to plan his rotations on a definite system with reference to his total acreage, so in properly managed timber-growing must areas be arranged in such a way that some part of the forest will be yielding annually its final return of mature crop, and cleared areas will by a natural process of regeneration replenish themselves without recourse to the expensive operation of planting being necessary. Scientifically worked a forest area of suitable land, of which there is such abundance in Britain, should be capable of yielding an annual net revenue as regular as that obtainable by any other form of soil cultivation.

19. It is nevertheless frequently urged as a reason for not growing timber that wood will not pay in Britain. A landowner will tell you he has acres of land which do not return him more than half-a-crown, and if it would pay better he would be glad to put them under timber, but he does not believe it would; and he will point to rates on woodlands which must be paid although no crop is being reaped. He will de-

monstrate that there is no market for home timber, which seldom fetches its value, and that there is a prejudice against it which increases the difficulty of any attempt to compete with the foreigner.

20. There is some reason in the latter part of this contention. The wood-grower in Britain has I think just cause for complaint when he finds his produce not only handicapped by preferential transport rates to foreign timber, as has been the case in the past, but that it is also disparaged by exclusion from, or admission only under conditions to, competition with foreign timber by the terms of building specifications. It is said to be the common practice of architects and others to bar home timber in this way, and the Government itself has not been guiltless in the matter. The Post Office form of tender a couple of years ago for telegraph poles entirely cut out native produce from competition, and the conditions of contract framed by the Board of Agriculture under the Land Improvements Act were until recently almost prohibitive to home timber. These latter are now modified, but whether or not the Post Office still boycotts home produce I cannot say.

21. However it is come about - and there are no doubt various effective causes—this undervaluing of home-grown timber is quite unreasonable, and the slur cast upon it is undeserved, so far as its quality is concerned. At the same time, there is ground for saying that the difficulties, occasioned in this and other ways, of disposing of home timber at remunerative prices are due to causes not altogether beyond the control of landowners who grow timber.

22. It is generally admitted that with a more regular and certain supply, as well as a larger amount in different districts, home timber would have a better chance of holding its own in the market. This is just what scientific forestry would bring about. Given a systematic cultivation of forest on scientific principles of rotation, and the conditions are prepared for a steady output of timber by annual cut, as well as for a supply of raw material for utilisation in the manufacture of the many subsidiary products derivable from forest growth. If landowners would only provide such supplies, they would alter altogether, and to their own advantage, the conditions under which they dispose of so much of their home wood. The timber merchant who now travels hither and thither over the country picking up small lots where they may occur for transport to his, probably distant, mills, at a cost which eats a big hole in the value of the trees to the landowner, would find it worth his while—and for that matter, it would be worth while for the landowner himself—to erect in the vicinity of the forest, mills for the purpose of converting and preparing the timber, and to put up machinery for the extraction of useful products from the waste wood. In such conditions a steady market could be created in which the advantage would lie altogether on the side of the home grown article, and materials, the debris of the forest, now thrown aside as useless, would be turned to account to the greater benefit of the landowner. Encouragement, too, would be given to the establishment of local industries dependent upon forest growth, through which fresh outlets for forest produce would be provided.

23. The amount of profit returnable from timber cultivation must of course vary with the circumstances of the area in each case, but in com-

paring values it must always be borne in mind that timber land is land which can yield no agricultural rent. The official statistics relating to continental State forests show us the result of forestry on a large scale, and it is interesting to note how, under what we must believe to be an equally efficient system of forestry management, the net revenue from the several areas differs greatly. Thus from its two million acres of forest area Bavaria draws a little over five shillings per acre per annum. Wurtemberg, with nearly half a million acres, gets a return of about eleven shillings; and Saxony, with a somewhat less area, receives over seventeen shillings per acre per annum. For this country we have no such figures. Our State forests result in a loss. It is unfortunate, too, that no returns are available from private forests and woodlands, either in Britain or abroad. Estimates of possible profits in this country we have abundantly, but solid figures of expenditure and receipt in relation to timber growing there are none. By the favour of Mr. Munro-Ferguson, M.P., who, as a landowner exhibits a most enlightened spirit in regard to forestry, I am however, able to cite the case of a pine and larch wood at Novar, in Ross-shire, twenty-four acres in extent, which was clean cut in 1883, and gives instructive figures. After sixty-one years' growth on land similar to that which in the neighbourhood yields a grazing rent of from one to two shillings per acre, it is found to have yielded a net sum equal to a revenue to the landlord during the whole period of its growth of over nine shillings per acre per annum, or an increased value of quite seven shillings per acre per annum. Although it refers to only a single wood of limited extent, this return shows how profitable waste land may become under timber. No doubt from the estates of other of our landlords who own extensive woodlands, where, if there is not the highest scientific forestry, there is certainly good wood management, results of an equally instructive kind could be obtained—many would be better; and it is much to be desired in the interest of forestry that they should be made known as an object-lesson to those who doubt the profit of tree-growing.

24. But in the return I quote from there is another interesting point which I must not fail to note. During the period of growth of the wood, the outlay upon labour in connection with it amounted to a sum equal to an expenditure of over thirty-one shillings per acre per annum. That is to say, this sum was distributed in wages to the people of the neighbourhood. This exhibits the benefits brought in the train of forestry, which are no less important to the community at large than is the profit of the crop to the landowner. The scientific treatment of woodlands and cultivation of forests for profit on a proper scale involve the employment of a considerable amount of labour, much of it at a time when there is little else doing in country districts, not only in the actual tending of the forest area, but in the manipulation and subsequent preparation of the timber, and in the manufacture of the numerous by-products obtainable from it. In these days of congestion in cities the importance of the development of such an industry which can provide occupation in the country, and thus may aid in restraining migration to the towns, has not escaped notice, and it cannot be too often or too greatly emphasised.

25. The influences, to which we have just given attention, that have prevailed in bringing about the present limited area of woodland in

Britain are, it will be seen, not wholly irremovable, nor are the obstacles to betterment insurmountable. And the question we have now to discuss is—How are these to be counteracted and overcome? By what means is it possible to bring forestry in Britain more in line with that of other nations? At the outset I would say that if forestry is to be established on a sound commercial basis, the only one on which it should rest, if we are to have a national home-timber industry, it can only be when the issues involved are more fully realised than they are nowadays. As in agricultural practice failure can only be obviated by the application of scientific methods in farm cultivation, so is it with forestry. To become a profitable industry it must be practised as an applied science, and not as an empirical routine.

26. We live beyond the days when it would be possible to apply the autocratic remedy for want of woodlands introduced in Scotland by the Jacobean Statute, which compelled the landlords not only to plant wood and Forest and make hedges, but also enjoined them under penalties to see that each of the tenants planted one tree for every mark of land. Nor, indeed, can much be said of the success of the compulsion. And I do not imagine anything could be gained nowadays by the method adopted in Scotland in the middle of last century by the "Select Society" as it was called, of offering a premium to farmers who planted the most trees within a specified time. That such processes were deemed necessary is interesting as showing how old standing has been the recognition of the want of sufficient woodland area in the country. At the present time there are those who would reverse, as it were, the process of the old statute, and who look to the acquisition by the State of large areas of waste land, and their afforestation by it, for the solution of this forestry question. It is, no doubt, a wise policy which encourages private enterprise to deal with the details of industries, and only invokes State aid as a directive and controlling force when its need can be clearly shown. That there is need for State aid in the case of forestry I do not deny, but it is not required to the extent just mentioned.

27. I unhesitatingly say that the State ought to treat the forest areas now in its possession in a reasonable and scientific manner, instead of leaving them as objects for the finger of scientific scorn. They might be made, in part at least, models of the best forestry practice. It is no use to dispute with the sentiment and taste which have prevailed in making the New Forest what it now is, and it is hopeless to expect an unanimous verdict as to the destiny of State woods and upon the method of treatment to which they should be subject. We have had recently, in the lively discussion regarding the management of Epping Forest, an illustration of how large is the number of people who have views upon the subject of the management of woodlands, and how the majority of them, if they had their way, would, through ignorance, defeat the very object they desire to accomplish. We must be prepared in any proposal for utilisation of State forests to incur the opposition of those who regard all scientific handling of woods as vandalism, although I do not know that forestry in itself involves a want of recognition of the beautiful, or dulls the feelings which a sylvan landscape invokes in the minds of those in touch with nature. It is allowed there are areas in our State forests sacred by many memories, possessing a grandeur and picturesque-

ness with which no hand, whether of forester or landscapist, would venture to meddle. But, on the other hand, there are tracts which without damage to the natural beauty, and without depriving in any sensible degree the people of their privileges of recreation they prize so much, might be and should be dealt with as forests cultivated on scientific principles. These might serve as instruction areas, showing all that is best for the information of foresters. The creation of some such experimental teaching stations in State forests is one of the essentials for forestry in Britain. I would go further and say that the area of State ownership should be increased to the extent of the establishment of forest stations, of an acreage sufficient to allow of a satisfactory rotation, in other parts of the country as centres of instruction. There have been, as you are aware, proposals for the afforestation of some of the three million and more acres of waste land in the Highlands of Scotland capable of growing timber, and we await with some interest the report of the Deer Forest Commission, which has taken evidence on the subject. If, as has been suggested may be possible, afforestation is attempted through any system of State-aided planting, an opportunity would be afforded for securing what would be of so much advantage to the country. Beyond this system of model experimental stations, the State ownership of forest in Britain does not seem to me to be necessary in the cause of forestry.

28. Replying recently to Sir John Lubbock in the House of Commons, the President of the Board of Agriculture, after recounting what his Board is now doing for forestry in Britain, added: "I shall always be glad to receive and to consider any suggestion for the increase of sound technical knowledge on this subject." Well, now, I have a suggestion to make. In a practical science like forestry "an increase of sound technical knowledge" can only be possible when facilities for practical instruction are provided. I would, therefore, ask the President to consider what I have just said with regard to State forest experimental areas. These cannot, of course, be created by a stroke of the pen, but the initiative for their formation would naturally come from the Board of Agriculture. It is possible that, with betterment in forestry practice, landowners might be found who would be willing to devote portions of their land for the purposes of instruction, following for forestry the noble example of Sir John Lawes in his work for agriculture; and everyone interested in forestry must hope this may be so. But when the State has already in its hands the means through which a large national industry can be fostered, it is surely incumbent on it to utilise them for the purpose. And mark you, in asking for this, one does not make a large demand upon the Treasury. The whole could be done at no ultimate cost, for the profits from the areas could unquestionably more than repay any outlay incurred upon them.

29. The true solution of the forestry question in Britain is to be found in the diffusion of accurate knowledge of forest science. The landowner has to be convinced that through scientific forestry a sound and profitable investment for his capital is to be found in woodlands; the factor or land agent must be instructed in the scientific principles of tree-growing for profit to enable him to secure a steady income to the landowner from his invested capital; and the working forester has to be taught methods of cultivation based upon science, by which his

faith in traditional practice, when it is, as is so often the case, unscientific, may be dispelled. It is through education alone that we can arrive at improved forestry.

30. This was recognised by the Select Committee upon Forestry of the House of Commons in its report in 1887, which performed a very valuable service by its exposure of the prevalent ignorance of scientific forestry and of well-known facts of tree-cultivation amongst those professedly engaged in its practice and study—an ignorance the continued existence of which manifests itself in some of the writings in current periodicals. The remedy it suggested of a State Forest Board, including representatives of science and of bodies interested in forestry, charged with the superintendence of the formation of forest schools and the preparation of forest literature, was superseded by the later institution of the Board of Agriculture, in which were absorbed such functions in regard to forestry as the Government of the day accepted. We are so accustomed to anomalies in our administrative system that the discovery of an additional one hardly surprises us. Yet it is difficult to understand why it is that a Board which deals with subjects so essentially based on science as does the Board of Agriculture should not have on its staff scientific men representative of the fields of science within its purview. But I do not know that either agriculture or forestry is so represented. It seems odd that this Board should be dependent for scientific advice upon outsiders, and now that it proposes to undertake the responsibility of the publication of a journal which, I take it, will be a means for the circulation of accurate information upon scientific questions, I do not see how its functions can be adequately performed without scientific help from within. No one of us would expect to see, either to-day or to-morrow, in this country a Board of Agriculture with an organization like that of the similar department in the United States, which excites our admiration by the excellence of the practical information it circulates. But there is a wide interval between the completeness of the American department and the incompleteness of ours; and if I may make another suggestion to the President of the Board of Agriculture, I would ask him to consider whether it would not strengthen the Board in the discharge of its rapidly growing functions if it had competent scientific advisers upon its staff. Such a man for forestry would, I believe, do much for "the increase of sound technical knowledge" in Britain, and promote to no little extent its interests.

31. Since 1887 we have made some advances along the lines of improved literature and of teaching pointed out by the Select Committee as those by which reform could be accomplished.

32. If one looks at the literature available up to a recent period to anyone desirous of learning something about forestry, one need feel little surprised at the ignorance which prevailed. It was alike meagre in amount and deficient in quality, consisting chiefly of the records of empirical practice of men who had had no scientific training. It is satisfactory to note that these are now being replaced by works having some pretension to scientific method and accuracy. From Cooper's Hill there is issuing, more slowly than could be wished, Prof. Schlich's excellent "Manual of Forestry," and from his colleague Prof. Fisher we may, I believe, soon expect an important forestry book. You all know

Prof. Marshall Ward's lucid little books on timber and plant-diseases, and we are promised immediately, under his editorship, a translation of Hartig's "Diseases of Trees," by Prof. Somerville. A most valuable and interesting contribution to forestry literature is the book by Dr. Nisbet, recently issued from the Clarendon Press, containing the lectures he delivered in the University of Oxford during the past year; and to his marvellous energy we shall owe the new edition of "Brown's Forester," which is shortly to appear, and an English version of Hartig's "Text-Book" for foresters. All this activity shows an increasing interest in forestry, but it is only the beginning of a movement to make up for the preceding dearth. Botanists are greatly indebted to the Delegates of the Clarendon Press—and it is fitting I should here acknowledge the obligation—for the splendid series of standard foreign works on botany they have brought within the reach of English-speaking students, and which have done so much for the progress of botany in Britain. If we have now got beyond the stage of dependence in pure botany, we are far from it in scientific forestry, and I would hope that the Clarendon Press will add to its botanical series some of the standard foreign forestry books, and thus aid in the dissemination of the knowledge so essential to progress in the subject.

33. I must not omit to refer here to the excellent opportunity that is afforded for the circulation of scientific information by the new journal of the Board of Agriculture, of which intimation has recently been made, and it is to be hoped that forestry will find a place in it side by side with agriculture.

34. The attention paid to the teaching and study of forestry by continental States, their many schools and copious literature of forestry, make it remarkable that, apart altogether from the economic side, forestry as a subject of study and investigation has not been long ago introduced in some of our teaching centres. I think the Sibthorpian Chair of Rural Economy of the University of Oxford was for long the only one through which forestry was recognised as within the sphere of University education. So far the limited tenure of this chair, in its new dress, has been held by agriculturists—in their line the most distinguished men; but I should like to think that one may look forward to a time when forestry shall have its turn, if by that time it has not come about that it is otherwise provided for.

35. It was, however, only the necessities of India which, at a comparatively recent date, led to the first starting of forestry teaching in Britain, and then only at the cost of India, and for those destined to serve there as foresters. Cooper's Hill College, the outcome of these, with its excellent equipment—including now, I believe, a slice of Windsor Forest for purposes of practical work—possesses the elements of a successful forestry school, and it has within recent years opened its doors to outsiders who may wish to learn forestry. But, so far as I am aware, it does not draw the young landowners of the country as it should do. Possibly the expense of the special education, which equals that of the universities without offering the advantages in other directions they afford, may be deterrent; but I am inclined to think that if the authorities made the fact better known that men other than foresters for India are admitted to the college, more would avail themselves of the opportunity.

36. Beyond this and some slight notice of forestry at agricultural colleges, there have been no facilities for forestry-teaching in Britain until within the last half-dozen years. I leave out of reckoning mere examining boards. Can we wonder, then, that there is a general want of intelligent appreciation of scientific forestry? Even now all that has resulted from the agitation in favour of more attention being given to this subject is—a lectureship on forestry in the University of Edinburgh, supported partly by the Board of Agriculture and partly by an endowment from subscriptions among landowners and others (and, I may mention here, forestry is now included as an optional subject in the university curriculum for an agricultural degree); a chair, or part of one, in the Royal College of Science at Newcastle, founded conjointly by the Board of Agriculture and the County Council; a course of instruction in science for practical foresters in the Royal Botanic Garden at Edinburgh, maintained by the Board of Agriculture; and a lecture course on forestry in the Glasgow and West of Scotland Technical Institute, similarly provided for. I must not omit to mention, too, the beginning, just made, by the Surveyors' Institute of the formation of a forestry museum in London, which should have an important educative influence. Little though it is, I think there is occasion for congratulation that even so much has been done to provide instruction, and I would have you note that in this education the different classes concerned with forestry are all recognised. Valuable as the teaching so being given is, it must have an effect in showing the need there is for more. In one way the teaching of all these bodies is incomplete, and must be imperfect, inasmuch as they have not the means for practical forestry work. Until this is provided, as I have indicated already, the teaching of forestry cannot be thoroughly carried out.

37. But, after all, what has been done in the way of supplying our wants in the way of teaching is nothing to what is required if forestry is to be adequately taught in Britain. Dr. Nisbet, who in his book already mentioned, has had the last say on this question, boldly states the requirements at six forestry chairs in universities, and four schools of practical silviculture in the vicinity of forests. I do not think he puts the needs one whit too high. I should be even disposed to add to them, because I note he has omitted to take into account the claim of Wales, whence there has recently been a request for the establishment of forestry teaching.

38. But there are two questions strictly pertinent to this demand, which need answering if the proposals are to be brought within the sphere of practicability—firstly, whence are the funds to be obtained for this organisation; and, secondly, where are we to get the teachers?

39. Dr. Nisbet puts his hand in the Treasury pocket for the money—some five thousand pounds per annum—required by his scheme. I do not think many of us will be so sanguine as to expect the whole financial aid could be directly obtained in this way. But it may be, I think, of significance in regard to this to consider the sources from which money has been forthcoming for what has already been done. The Government, through the Board of Agriculture, has given most; the remainder has come from the County Councils and from private contributions.

40. There is no reason to suppose that the Board of Agriculture will be less willing in the future than it has been to aid in the establishing of forestry teaching in suitable centres; but its support from the limited funds—eight thousand pounds—at its disposal for educational purposes, is always given as a grant in aid, and is contingent upon evidence of local effort towards the end desired, which we must therefore look to in the first instance.

41. It is of no use to speculate upon the prospects of private munificence providing equipment in any centre. We may hope for it, but I do not think times are such as to lead us to expect large pecuniary aid from landowners. After vigorous effort amongst them, extending over some years, to secure an endowment for a chair of forestry in Edinburgh, a sum a little over two thousand pounds is all that has been raised.

42. But forestry is one of those subjects to the teaching of which we may be more sanguine of support from County Councils. It will always be a matter of regret to scientific men, and those interested in the industrial progress of the country, that the grand opportunity furnished by the fund dealt with under the Local Taxation Act (1890) was not taken more advantage of by the Government of the day. Distributed, even in part, through representative educational institutions, it could have provided equipment for technical education of the highest kind beyond our dreams. Thrown at the heads of the County Councils, before these bodies had had time to settle to their prescribed work, there has been, in the opinion of those well qualified to judge, no little waste. You could not create all at once the machinery requisite for the most efficacious expenditure of half a million of money on technical teaching. Much of the work done by these bodies is admirable. It is indeed surprising in the whole circumstances how efficiently technical instruction has been carried out, and no doubt it will improve. But it had a most extravagant start. It is difficult to trace, in the general returns of the technical education undertaken by the County Councils, the details of their work, and I have not been able to discover how far forestry has been treated as a subject of instruction. It has not, I think, been often included. But the example of Northumberland and Durham in respect of the Newcastle chair is one that gives encouragement for thinking that if the due importance of forestry to the community were made clear, County Councils, in districts favourable for forestry and its concomitant industries, might come forward with some of the financial support needed for the provision of the educational equipment.

43. It appears to me that, whilst we must obtain from the Government the institution of silvicultural areas for practical instruction our best chance of success in acquiring the necessary endowment for the rest of the teaching lies in the line of combination between the Board of Agriculture and the County Councils, with, it may be, aid from private benefactors. But if we were to draw financial support from County Councils, or from private sources, we must as a first step towards this make known, more thoroughly than it is, the nature of the national interests involved. We must disabuse landowners, land agents, and practical foresters of the notion that forestry consists in the random sticking in of trees, which anyone, no matter how unskilled, may accomplish. We must bring home to the people's minds that in science is to be

found the only sure guide to proper timber-growing, and that scientifically managed forests are alike a profit to the producer, a benefit to the community of the region in which they are reared and a source of national wealth. Once we have got so far as to create this opinion, the funds for as extended a scheme of forestry education as may be necessary will I venture to think, be forthcoming.

44. There is still the other question to answer—Whence are the teachers to come? This is, I think, fundamental. For, given a competent teacher, he will soon find opportunity for teaching. If tomorrow the whole or even a half of the chairs suggested by Dr. Nisbet as essential were founded, how should we meet the demand for men to fill them? We might, of course, draw upon the Indian Forest Service, but I do not know where you would find teachers in Britain. But if there is no prospect of such immediate requirement of teachers, that does not make the fact of their deficiency of any less moment. There is surely something wrong when men capable of giving scientific instruction in so important a practical subject are so scarce.

45. This is how it touches us botanists, and upon our shoulders I am disposed to throw the blame for the present outlook. We do not seem to have realised, except in relation to medicine, that modern botany has an outlet. Perhaps it has been the influence of medicine that has engendered this. We find chemists and physicists devoting their science to the furtherance of practical aims. Zoologists have applied theirs to the elucidation of problems bearing on the fishery industry, and we see in that monument to the ability and energy of Prof. Ray Lankester, the marine biological laboratory at Plymouth, an experimental station which, while it contributes to the nation's prosperity, serves at the same time as a home of pure research. But where is the practical outcome of modern botany? I must not overlook such brilliant work as that of Marshall Ward, full of purpose, and significant as it is to many large industries, nor that of Oliver in its bearing on horticulture. But it does seem to me that the general trend of botanical work in Britain is not utilitarian. Perhaps as good an illustration as could be given of the slight practical importance attached by the lay mind nowadays to botany is the fact that the Scottish Universities Commissioners have made it—though I must add it is bracketed with zoology—optional with mathematics for the degree in agriculture.

46. It is a matter of history that its utilitarian side gave the first impetus to the scientific study of botany. The plant-world, as the source of products of economic value and drugs, attracted attention, and out of this grew, by natural development, the systematic study of plants. The whole teaching of botany was at the first, and continued for long to be, systematic and economic, and it was from this point of view that, the herbalist having become the physician, botany became so essential a branch of medical study. It is noteworthy that as an early practical outcome of the study came the establishment of botanic gardens, which, at their institution, were essentially what we would now style experimental stations, and contributed materially to the introduction and distribution of medicinal and economic plants, and to the trial of their products. If they are now in many instances simply appendages of teaching establishments, or mere pleasure-grounds, we at least in Britain

are fortunate in possessing an unrivalled institution in the Royal Gardens at Kew, which still maintains, and under its present able Director has enormously developed, the old tradition of botanic gardens as a centre in our vast empire, through which botany renders scientific service to our national progress.

47. In Britain, consequent perhaps on our colonial and over-sea possessions, the systematic side of botany continued predominant long after morphological and physiological work had absorbed the attention of the majority of workers and made progress on the continent. Not that we were wanting in a share of such works, only it was overshadowed by the prevalent taxonomy, which in the hands of many no longer bore that relation to its useful applications which had in the first instance given it birth, and had become little more than a dry system of nomenclature.

48. The reaction of a quarter of a century ago, which we owe to the direct teaching of Sachs and De Bary and the influence of Darwin, many of us can remember; in it some who are here today had a share. Seldom I think is a revolution in method and ideas of teaching and study so rapidly brought about as it was in this instance. The morphological and physiological aspect of the subject infused a vitality into the botanical work which it much needed. The biological features of the plant-world replaced technical diagnosis and description as the aim of teachers and workers in this field of science. No weightier illustration of the timeliness of this change could be found than in the attitude of medicine. But a few years ago he would have been rash who would predict that botany would for long continue to be recognised as a part of university training essential to medical students. Its utility as ancillary to *materia medica* had lost point through the removal of pharmacy from the functions of the physician. But what do we see now? Not the exclusion of botany from the university curriculum of medical study, but the recognition to such an extent of the fundamental character of the problems of plant-life, that it is now introduced into the requirements of the colleges.

49. But if the old taxonomic teaching was stifled by its nomenclature, there is, it seems to me, a similar element of danger in our modern teaching, lest it be strangled by its terminology. The same causes are operative as of old. The same tendency to narrowing of the field of vision, which eventuates in mistaking the name for the thing, is apparent. With the ousting of taxonomy, and as the laboratory replaced the garden and museum, the compound microscope succeeded the hand-lens, and for the paraphernalia of the systematist came the stains, reagents, and apparatus of microscopical and experimental work as the equipment necessary for the study of plants, the inwards rather than the outwards of plants have come to form the bulk of the subject matter of our teaching, and we are concerned now more with the stone and mortar than with the general architecture and plan of the fabric; we are inclined to elaborate the minute details of a part at the expense of its relation to the whole organism, and discuss the technique of a function more in the light of an illustration of certain chemical and physical changes than as a vital phenomenon of importance to the plant and its surroundings. This mechanical attitude is quite a natural growth.

It is a consequence of specialisation, and it is reflected in our research. But it must be counteracted if botany is in the future to be aught else than an academic study, as it was of old an elegant accomplishment. It has come about very much because of that want of recognition by botanists, to which I have already referred, of the natural outlets of their study—of their failure so far to see the lines through which the subject touches the national life. Modern botany has not yet found in this country its full application. It has not yet rendered the State service as it ought, and as was done by the taxonomic teaching it supplanted.

50. It is from this point of view that I wish to point out to you to-day that through forestry—and although I have particularly dealt with this branch of Rural Economy, what I say is equally true of horticulture and agriculture—modern botanical study should find a sphere of application by which it may contribute to our national well-being, and which would have a directive influence upon its teaching, taking it out of the groove in which it tends to run. What we botanists need to do in this connection is to teach and to study our subject from a wider platform than that of the mere detail of individual form, and to encourage our pupils to study plant-life not merely in water-cultures in the laboratory, but in the broader aspects exhibited in the competitive field of nature.

51 If forestry is ever to thrive in Britain, botanists must lay the foundation for it in this way. We cannot expect to make our pupils foresters, nor can they get the practical instruction they require in Britain. In this we must depend yet awhile on continental schools; the stream of continental migration, which needs no longer to flow in morphological and physiological channels, must now turn in the direction of forest schools. But we can so mould their studies and give bias to their work as will put them on the track of this practical subject. If we had only a few men so trained as competent foresters, and capable of teaching forestry, there would be an efficient corps with which to carry on the crusade against ignorance and indifference, the overcoming of which will be the prelude to the organisation of forestry schools and scientific silviculture in Britain. The influence of the individual counts for much in a case like this. The advent of a capable man started forestry teaching in Scotland, which years of talk had not succeeded in doing. And so it will be elsewhere.

I have endeavoured, thus briefly, to sketch the position, the needs, and the prospects of forestry in Britain. Its vast importance as a national question must sooner or later be recognised. It is a subject of growing interest. Its elements are complex, and it touches large social problems; but the whole question ultimately resolves itself into one of the application of science. To botanists we must look in the first instance for the propagation of the scientific knowledge upon which this large industry must rest. They must be the apostles of forestry. And forestry in turn will re-act upon their treatment of botany. Botany cannot thrive in a purely introspective atmosphere. It can only live by keeping in touch with the national life, and the path by which it may at the present time best do this is that offered by forestry.

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SEEDS.

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- Albizzia Julibrissin.
 Chamaecyparis obtusa.
 " pisifera.
 Cinnamomum Camphora.
 " Loureirii.
 Cladrastis amurensis.
 Cornus macrophylla
 Cryptomeria japonica
 Edgeworthia papyrifera
 Euonymus alatus
 Eurya japonica
 Euscaphis ataphyleoides
 Gleditschia japonica
 Ilex integra
 Limonia trifoliata

- Myrica rubra*
Rhus succedanea
 " *vernificera*
Skimmia japonica
Smilax China
Sterculia platanifolia
Styrax japonica
Torreya nucifera
Zelkova acuminata
From Botanical Gardens, Saharanpur.
Combretum nanum
Dalbergia latifolia
 " *paniculata*
Diospyros melanoxylon
Ixora parviflora
Ichnocarpus frutescens
Lebidieropsis orbicularis
Schrebera Swietenoides
Soymda febrifuga
Strychnos potatorum
Xylia Dolabriformis
From Botanic Gardens, Trinidad.
 " *Peter's* Mango
 " *Gordon* Mango
From Botanic Gardens, Singapore.
Artocarpus rigidus
From Southern Californian Acclimatisation Assn. California.
Acacia flexicaulis
Acrocomia havanensis
Casimiroa edulis
Ficus aurea, var. latifolia
Ehretia elliptica
Pithecolobium brevifolium
Prunus capuli
From Botanic Gardens, Ceylon.
 Dolichandrone Rheedii
From Mr. C. W. Meaden, Trinidad—
 Piper nigrum
From Government Botanist, Melbourne.
 Dendrocalamus membranaceus
 Atriplex vesicarium
From Government Botanist, Demerara.
 Borassus flabelliformis
From Messrs. Beasoner Bros. Florida—
 Phoenix leonensis X *canariensis*
From Mr. S. J. Batson, Mandeville -
 Erythroxylon Coca.
-

JAMAICA.

BULLETIN

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Vol. I.

Parts 10, 11 & 12.

CASTLETON GARDENS.

NOTES ON THE MOST INTERESTING PLANTS.

CASTLETON GARDENS is scarcely 30 years old, and therefore as a Botanic Garden, it is still in its infancy. It is however the only representative of a Botanic Garden in Jamaica, as the old Garden at Bath is reduced to the smallest dimensions, and has been shorn of the glory of former days.

Castleton is 19 miles from Kingston, but the drive there and back more than compensates for the distance. In going to Castleton we pass through some of the most characteristic and beautiful scenery in the Island. To the stranger the marvellous variety of the tropical vegetation is simply bewildering. He sees perhaps for the first time groves of the bread-fruit tree with its handsome foliage, endless clumps of the feathery bamboo, rows of the truly tropical banana, and in the alluvial soil of the valley of the Wag Water acres of well cultivated tobacco plants, while the hills arise on either hand, their sides covered with patches of yams, sugar cane, cocoa, coffee, coco-nut-palms, &c.

To those who have lived long in the island, these natural products will be familiar in themselves, but still the combination in endless variety is always novel and always charming, so that the ever changing scene with the river below and the fertile hills above so occupy the attention that Castleton is reached almost too quickly.

1. *ÆGLE MARMELLOS*, *Corr.*—The ripe fruit of this Indian Tree, the "Bael" fruit, is said to have an exquisite flavour and perfume. The unripe fruit is cut up, sun-dried, and used in cases of dysentery. (*Rutaceæ.*)
2. *ALEURITES TRILOBA*, *Forst.*—The Candlenut, sometimes called Walnut, grows to a height of 30 to 40 feet. The seeds yield oil, which is a good drying oil for paint. In the Sandwich Isles 10,000 gallons are annually produced, and used there as a mordant for their vege-

NOTE.—The numbers before the names refer to the Plan.

table dyes. The cakes left after the oil has been expressed, is used as food for cattle and also as manure. It thrives along roads. (*Euphorbiaceæ*.)

3. *AMHERSTIA NOBILIS*, Wall.—To those who are fortunate enough to arrange their visit in the early part of the year, almost the first object on entering the gate, the *Amherstia nobilis*, will be a joyous surprise.

Dr. Wallich, Director of the Botanic Gardens, Calcutta, gives an account of his discovery of this Prince of Flowering-Trees. In March, 1827, he accompanied the British Envoy to Ava, and in his official report of a journey on the River Saluen, in order to examine the site and capabilities of the Teak forests in that direction, thus writes: "In about an hour I came to a decayed Kioum (a sort of monastery), distant about 27 miles from the town of Martaban. There were two of these trees here; the largest, about 40 feet high, with a girth at 3 feet above the base, of 6 feet, stood close to the cave; the other was smaller. They were profusely ornamented with pendulous racemes of large vermilion-coloured blossoms, forming superb objects, unequalled in the flora of the East Indies, and, I presume, not surpassed in magnificence and elegance in any part of the world. The ground was strewn, even at a distance, with its blossoms, which are carried daily as offerings to the images of Buddha in the adjoining caves. Round the spot were, also, numerous individuals of *Saraca indica* in full bloom, inferior in beauty only to those trees."

This tree, which "when in full blossom is the most strikingly superb object that can possibly be imagined", Dr. Wallich named in compliment to Lady Amherst.

The Duke of Devonshire sent a collector to Birma on purpose to procure a plant, and in 1839 the first living specimen was successfully brought to Chatsworth. However, a plant presented by the Governor-General, Lord Hardinge, to Mrs. Lawrence, in 1847, was the first to flower in England in 1849, when it was only 11 feet high.

For its perfect development, this tree requires a hot damp atmosphere. (*Leguminosæ*.)

4. *ARAUCARIA BIDWILLII*, Hook.—The Bunya-bunya Pine of Queensland has a large edible seed. It is the loftiest of the Araucarias, reaching a height of 250 feet. The timber is suitable for furniture, being beautifully streaked; it is hard, close-grained and durable.

It is said that the Araucarias agree with the Eucalypti in their antiseptic exhalations which destroy fever-germs in malarial districts. (*Coniferæ*).

5. *ARAUCARIA CUNNINGHAMII*, Sweet.—The Moreton Bay Pine forms forests in eastern Australia and New Guinea. It grows from 100 to 130 feet high. The timber takes a high polish, and compares favourably with satin-wood and birds-eye maple.

Both this and *A. excelsa* grow at the rate of about two feet a year, in almost any soil, and would doubtless succeed at any elevation in Jamaica. (*Coniferæ*)

6. *ARAUCARIA EXCELSA*, *R. Br.*—The Norfolk Island Pine is a lofty tree of symmetrical growth, with the branches arranged in regular horizontal tiers. Some of the trees in Norfolk Island on the coast of Australia are 220 feet high. The timber is used for building and other purposes. (*Coniferae*).

7. *ARAUCARIA IMBRICATA*, *Pav.*—The Chili Pine or Monkey Puzzle, is a native of rocky eminences on the Andes. It forms vast forests in southern Chili from snow-line to 2,000 feet below it. The tree attains a height of 150 feet. The timber is yellowish-white, and beautifully veined; it is easily worked, takes a polish and is very durable. It is a tree of great importance to the Araucanian Indians, as the seeds are edible, and it is said that the produce of 18 trees will yield sufficient food to sustain a man for a whole year. Besides eating the seeds either fresh boiled or roasted, the natives dry them for winter store, prepare a kind of flour from them, and also distil them into spirit.

Nearly a hundred years ago, the great navigator, Vancouver, was returning home from a survey of the north-west coast of America, and putting in at Valparaiso, was entertained by the Viceroy of Chili. At dinner, Menzies, the botanist of the expedition, noticed some nuts which were unknown to him, and instead of eating any he carried some with him and raised five seedlings on board in a box of soil. Thus the Monkey Puzzle tree was, for the first time successfully introduced into England at the termination of their voyage in the autumn of 1795. The tree is now fairly common in England, and sometimes ripens its seeds. (*Coniferae*)

8. *ARECA CATECHU*, *Linn.*—The Areca or Betel-nut Palm has a lofty, straight and very slender stem,—the Hindoo poets speak of it as “an arrow shot from Heaven.”

Low, in his ‘History of Borneo,’ says:—“The flowers are deliciously fragrant; they are in request for all festive occasions, and are also considered a necessary ingredient in the medicines and charms employed for healing the sick; their delightful perfume together with the graceful feathery foliage, borne on a slender and elegantly tapered stem, renders this tree the universal favourite among the Palm tribe.”

The fruit is about the size of a small hen’s-egg, of an orange colour, and hangs in long bunches below the dark green leaves. The outer part of the fruit is hard and fibrous, then comes the shell, enclosing the kernel of Betel-nut.

It is for this nut, that the palm is so extensively cultivated in the Malay Archipelago, and the practice of chewing it is universal amongst the natives. The nut is cut into narrow strips, and rolled up with a little lime in the leaves of the Betel Pepper. The pellet, though acrid to the taste is aromatic and astringent, and the mastication is considered wholesome. The natives would rather forego meat and drink than their favourite Areca Nut. The commerce in the nut is enormous. (*Palmae*.)

9. *ARENCA SACCHARIFERA*, *Labill.*—The Sugar Palm is most abundant in shady forests on the banks of streams in Burma and the Malay

Archipelago. It is so useful, that it is extensively cultivated, especially in hilly districts. It grows to a height of 30 or 40 feet.

At the base of the leaf-stalks is produced a fibrous material like coarse black horse hair which makes an excellent and durable cordage, resisting the action of water. Used as thatch, the roof never requires renewal. The coarse parts are used by the natives as pens. The gossamer-like substance underneath the fibre is exported to China for tinder.

But this palm is grown chiefly for the production of sugar and palm-wine. Wallace gives the following account :—

“The sap which pours out of the cut flower-stalk of several species of palm when slightly fermented, forms palm-wine or toddy, a very agreeable drink; and when mixed with various bitter herbs or roots which check fermentation, a fair imitation of beer is produced. If the same fluid is at once boiled and evaporated, it produces a quantity of excellent sugar. The sugar-palm of the Malay countries, is perhaps the most productive of sugar. A single tree will continue to pour out several quarts of sap daily for weeks together, and where the trees are abundant this forms the chief drink and most esteemed luxury of the natives. A Dutch chemist, Mr. De Vry, who has studied the subject in Java, believes that great advantages would accrue from the cultivation of this tree in place of the sugar-cane. According to his experiments it would produce an equal quantity of sugar of good quality with far less labour and expense, because no manure and no cultivation would be required and the land will never be impoverished as it so rapidly becomes by the growth of sugar-cane. The reason of this difference is, that the whole produce of a cane-field is taken off the ground, the crushed canes being burnt; and the soil thus become exhausted of the various salts and minerals which form part of the woody fibre and foliage. These must be restored by the application of manure, and this, together with the planting, weeding, and necessary cultivation, is very expensive. With the sugar-palm, however, nothing whatever is taken away but the juice itself; the foliage falls on the ground and rots, giving back to it what it had taken; and the water and sugar in the juice being almost wholly derived from the carbonic acid and aqueous vapour of the atmosphere, there is no impoverishment; and a plantation of these palms may be kept up on the same ground for an indefinite period. Another most important consideration is, that these trees will grow on poor rocky soil and on the steep slopes of ravines and hill-sides where any ordinary cultivation is impossible, and a great extent of fertile land would thus be set free for other purposes.”

The juice of the fleshy covering of the fruit is so corrosive that it causes inflammation of the skin. When the natives of the Moluccas were defending their forts against the attacks of the Dutch, they employed a liquor prepared by steeping the fruit in water, and so powerful was its effects, that the Dutch gave it the appropriate name of “hell-water.”

The young kernels of the fruit are made with syrup into preserves.

When the last flower-stalk has appeared and the tree dies, the stem is found to be almost hollow; it is particularly well adapted

for troughs for water, and is very durable. All the central part of the stem is of a pithy nature, containing large quantities of starch.

If the tree is cut down before flowering, the starchy material is made into a wholesome meal, somewhat like sago. But if left to flower, the starch undergoes a natural change into sugar to build up the substance of flower and fruit. One tree yields about 150lbs. of meal. (*Palmæ.*)

10. *ASTROCARYUM VULGARE*, *Mart.*—The Tucum Palm of Brazil is somewhat similar to our native Groo-groo (*Acrocomia sclerocarpa*), and, like it, is covered with sharp spines.

It is of so much importance to the natives that where it does not already grow wild, it is carefully cultivated amongst their fruit trees and in their fields of cassava.

Cordage of exceeding fineness, and great strength and durability is prepared from the outer skin of the unexpanded leaves, which is stripped off and twisted into thread by rolling with the hand on the breast or thigh. It is chiefly used for bow strings and fishing nets on account of its special adaptation to such purposes. "The Brazilians of the Rio Negro and Upper Amazon make very beautiful hammocks of fine 'tucum' thread, knitted by hand into a compact-web of so fine a texture as to occupy two persons three or four months in their completion. They then sell at about £3 each, and when ornamented with the feather-work borders, at double that sum."—A. R. Wallace. (*Palmæ.*)

11. *ATTALEA COHUNE*, *Mart.*—The Cohune Palm is a native of Central America. Mr. R. Temple, when Chief Justice of British Honduras, called attention to this palm in the Journal of the Society of Arts nearly 40 years ago. "The Cohune resembles in appearance the Coco-nut palm, but it is not nearly so high as that tree, and the trunk is considerably thicker. The order and regularity in which it grows is surprising. I have seen rows of it presenting the appearance of having been planted with the greatest care, long avenues which closely resembled naves and aisles of a cathedral, the arched leaves meeting overhead, and producing an exact imitation of the vaulted roofs; if the sun was declining, the horizontal rays, shining at intervals through one side of the avenue, created the splendid effulgence of the most richly painted window.

"The Cohune bears a fruit about the size of a large hen's egg, which grows in clusters, each cluster resembling a bunch of grapes. The kernel tastes somewhat like that of the coco-nut, but is far more oleaginous, and the oil extracted from it is infinitely superior."

Notwithstanding the attempts made to introduce this oil into England, they have not been successful. Perhaps one reason is that the shell surrounding the kernel is hard and dense. (*Palmæ.*)

12. *AVERRHOA BILIMBI*, *Linn.*—The Bilimbi, has a somewhat similar fruit to the Carambola. The fruits grow on the trunk, and are used in pickles and curries. The flowers are made into preserves. (*Geraniaceæ.*)

13. *AVERRHOA CARAMBOLA*, *Linn.*—The Carambola of the East Indies is a small tree with leaflets which are slightly sensitive. It produces an abundance of prettily shaped five-angled yellow fruits. The fruits are acid, but make an agreeable preserve, and are also used for making pickles and curries; the juice removes iron-mould from linen, The dried fruit is given in fevers, and is also an antiscorbutic. (*Gernaceæ*.)
14. *BAPHIA NITIDA*, *Afz.*—Cam Wood has grown here to a height of 24 feet, and measures 30 inches in circumference at the base. It has papilionaceous flowers, white, with a small orange-yellow blotch near the base of the standard. Some hundred tons of the wood are imported into Great Britain annually from the west coast of Africa, but it is said not to be so easily obtainable at the present time. The logs are about 4 ft. long and a foot in diameter. It is a dyewood yielding a brilliant deep red colour, and is used for the same purposes as Brazil wood. The mordant employed is sulphate of iron; common English Bandana handkerchiefs are dyed with this material. In Africa the natives colour their bodies with the pounded wood, and make use of the wood also in Fetish ceremonies. (*Leguminosæ*)
Bar Wood is sometimes confused with Cam Wood, but it is a different tree, viz., *Pterocarpus erinaceus*. Poir.
15. *BARRINGTONIA BUTONICA*, *Forst.* has a remarkable four-angled fruit. From the seeds an oil is expressed, used for lamps. They are also mixed with bait to stupify fish. The fruits are employed as fishing-floats. (*Myrtaceæ*.)

16. *BASSIA LATIFOLIA*, *Roxb.*—Brandis in his 'Indian Forest Flora' says of the Mahwa tree:—"It attains 40 to 50 feet in height with a short trunk 6 to 7 feet in girth, and numerous spreading branches, forming a close shady rounded crown."

Mr. Lockwood, magistrate and collector in Monghyr, 250 miles north-west of Calcutta, has published a most interesting and instructive account of this tree. He says: "This tree may be called a fountain yielding food, wine, and oil to the inhabitants of the country where it grows." In appearance it might be mistaken for a mango tree. "But, unlike that of mango trees, which are uncertain in their yield, the Mahwa crop never fails; for the part eaten is the succulent corolla, which falls in great profusion from the trees in March and April. This season is a great feasting time for the humbler members of creation. Birds, squirrels, and tree-shrews feast among the branches by day, whilst the poor villagers collect the corollas which fall on the ground on all sides. Nor does the feasting end with the day. At sunset peacocks and jungle-fowl steal out from the surrounding jungle to share the Mahwa with deer and bears, many of which fall victims to the bullets or arrows of the hunters, who sit concealed in the branches overhead. It grows on poor, stony soil, ill-suited to most other trees, or for the plough."

Mr. Lockwood calculated that in Monghyr, a district of 4,000 square miles, there must be a million trees. Each tree yields 2 or 3 cwt. of corollas; so that the total yield of Mahwa flowers cannot

be far short of a 100,000 tons in Monghyr alone. Of this amount a vast quantity goes to feed the forest birds and beasts; but of that portion which is collected by the natives by far the greater part is eaten, and supplies nourishing food to the poorer classes.

During the season of scarcity which prevailed at Behar during 1873-74, the Mahwa crop, which was unusually abundant, kept thousands of poor people from starving. The residue of the Mahwa which is not eaten is taken to the distilleries, and then with the aid of rude pot-stills is converted into a strong-smelling spirit, which bears considerable resemblance to whisky. When the essential oil, which gives a peculiar smell, is removed, the spirit comes very near good brandy. In the island of Caranja, opposite to Bombay, the government duty on the spirits distilled (chiefly from this flower) amounts to at least £60,000 per annum.

The fruit which follows after the corollas have fallen, yields seeds from which a greenish yellow oil is produced. This is used to adulterate *ghi* or clarified butter. This substance has some commercial importance, inasmuch as it is worth £35 a ton for soap-making. (*Sapotaceæ*.)

17. *BAUHINIA VARIEGATA*, *Linn*, a native of India and China, is a beautiful shrubby-looking tree of 20 to 30 feet in height. The flowers are handsome of a rosy-white colour. The dark wood is sometimes called Ebony, but is of little use. The astringent bark has been used as a tonic in medicine, and also for tanning. (*Leguminosæ*.)
18. *BERTHOLLETIA EXCELSA*, *Humb. and Bonpl.*—This tree which yields "Brazil Nuts," grows to a height of from 100 to 150 feet, forming large forests on the banks of the Amazon and Rio Negro. The seed-vessel is a hard woody globular shell, 6 inches through, containing about 20 nuts beautifully fitting together in it. When they are ripe, they fall from the trees, and the Indians go in great numbers to collect them. They break the shell with an axe, and send boat loads of the nuts down the river to Para. (*Myrtaceæ*.)
19. *BIGNONIA MAGNIFICA*, *Bull* has large flowers, $3\frac{1}{2}$ inches across, varying in colour from delicate mauve to rich purplish-crimson, with a light primrose-colour throat. It is a native of Columbia, and was first introduced into English hot-houses in 1879. (*Bignoniaceæ*.)
20. *BOEHMERIA NIVEA*, *Gaudich*—This plant is known variously as Ramie, Rhea and China Grass. The fibre extracted from the young shoots is the strongest known, and also one of the most beautiful, looking much like silk. But the resinous matter of the stalk makes it very difficult to extract the fibre cheaply. The Government of India more than 20 years ago offered a prize of £5,000 for a good extracting machine for it, but none has yet been invented that gives satisfactory results. It is a native of Malaya. (*Urticacæ*.)
21. *CANANGA ODORATA*, *Hook. f. & Thoms.*—The Cananga is a native of Burma, Java and the Philippines, but it is cultivated as an orna-

mental tree throughout India and the tropics. It is a tall tree, with straight trunk and smooth ashy bark. The flowers are drooping, of a greenish-yellow colour, fragrant, and about three inches in length. It belongs to the same family as the Sweet Sop, but the fruit is not edible. It is the "Ilang-ilang" of European perfumers. An otto prepared from the flowers is worth from 18s. to 22s. per ounce. Macassar Oil is said to be a solution of Ilang in Coco-nut Oil.

A tree planted in Hope Gardens attained in 6 years a height of 46 feet, with a girth of 38 inches at 3 feet above the ground. (*Anonaceæ*.)

22. *CARLUDOVICA GRACILIS*, *Liebm.*—The Ippi-appi or Thatch Palm is used to make the Ippi-appi hats. It is a native of Jamaica.

23. *CARYOCAR NUCIFERUM*, *Linn.*—The Souari or Butter Nut is the product of a tree often attaining a height of 100 feet in the forests along river banks in British Guiana.

The timber is used for shipbuilding. The flowers are large, of a deep, purplish-brown colour; the fruit about the size of a child's head, encloses 2 to 4 nuts, which have a reddish-brown hard shell, enclosing a large white kernel of a very agreeable flavour, and yielding an edible oil. (*Ternstræmiaceæ*.)

24. *CARYOTA URENS*, *Linn.*—The Wine Palm or Kittul Palm attains a height of 50 or 60 feet, and is remarkable for the peculiar form of the leaflets, which have been compared to those of our common Maiden Hair Fern. The leaves themselves are from 18 to 20 feet long. It is a native of Ceylon and India, growing in forests in the hilly districts, where teak and the wild mango abound.

The Kittul fibre of commerce is prepared from the sheathing leaf-stalk; it is used as a substitute for bristles for making brushes, baskets, etc. The value is from 3½d. to 10d. per lb. It is said that in Ceylon ropes made from the fibre are used for tying elephants. Roxburgh says it is highly valuable to the natives of the countries where it grows. "It yields during the hot season an immense quantity of toddy, or palm-wine. I have been informed that the best trees will yield at the rate of one hundred pints in the 24 hours. The pith, or farinaceous part of the trunk of old trees is said to be equal to the best sago: the natives make it into bread, and boil it into thick gruel; these form a great part of the diet of the people, and during a famine they suffered little while the trees lasted." I have reason to believe this substance to be highly nutritious."

The Wine Palm ends its existence by flowering. The first flower stalk appears at the top of the tree; as soon as that has done flowering, another appears lower down, and so on, till the last one blossoms at the foot of the trunk, proclaiming that the death of the tree is near at hand. These flower-spikes hang down in large bunches, producing quantities of round, reddish berries. The wood is strong and durable, used for agricultural purposes, water conduits and buckets. (*Palmeæ*.)

25. *CASSIA FISTULA*, Linn.—The Indian Laburnum, has beautiful yellow flowers; it is a middle sized erect tree, reaching a height of 40 to 50 feet. The pulp round the seeds is a mild and laxative. (*Leguminosæ*.)
26. *CASSIA SIAMEA*, Lam.—(also known as *Cassia florida*) grows to a height of 80 feet at Castleton. It has large, showy, yellow flowers. It is native of India and Malaya. (*Leguminosæ*.)
27. *CASTILLOA ELASTICA*, Cerv.—The Castilloa Rubber tree has been described by Dr. Morris, who saw it growing in British Honduras on most of the cohune ridges, along the banks of rivers, and in the valleys. "It grows to a height of about 40 to 50 feet; has a thick clean stem, about 2 feet in diameter at the base, and in habit of growth much resembles a bread-fruit tree, to which it is closely allied. The leaves are large, oblong in shape, and clothed, especially in the young state, with a dense coat of hairs. The flowers appear in February or March." The tree is fit to be tapped when it is from 7 to 10 years old. The proper season is after the autumn rains, which occur some months after the trees have ripened their fruit, and before they put forth buds for the next season.
- Belt, in his charming book, the "Naturalist in Nicaragua," thus describes the process of obtaining the rubber. "When the collectors find an untapped tree in the forest, they first make a ladder out of the lianes that hang from every tree; this they do by tying short pieces of wood across them with small lianas, many of which are as tough as cord. They then proceed to score the bark with cuts which extend nearly round the tree like the letter V, the point being downward. A cut like this is made about every 3 feet all the way up the trunk. The milk will all run out of a tree in about an hour after it is cut, and is collected into a large tin bottle made flat on one side and furnished with straps to fix on a man's back. A decoction is made from another liana (the moon flower, *Ipomœa bona-nox*), and this on being added to the milk, in the proportion of one pint to a gallon, coagulates it to rubber, which is made into round flat cakes. A larger tree, 5 feet in diameter, will yield when first cut about 20 gallons of milk, each gallon of makes 2½ lbs. of rubber."
- The Castilloa tree is a deep feeder, preferring soil which is a deep loam. It may be grown along river-banks to give them stability. It grows rapidly, and in its native forests gives a return in rubber in 8 or 10 years.
- The name Castilloa is derived from the small town of Castillo on the river San Juan in Nicaragua, one of the centres of the rubber trade. "It was near Castillo that Nelson lost his eye. He took the fort by landing about half a mile lower down the river, and dragging his guns round to a hill behind it by which it was commanded." (*Urticacæ*.)
28. *CHRYSALIDOCARPUS LUTESCENS*, Wendl.—is a singular and handsome palm from Madagascar, with several stems growing from the same root. (*Palmæ*.)

- 29 CINNAMONUM CAMPHORA, *Nees & Eberm.*—The Camphor Laurel is a native of China and Japan; and in Formosa it covers the whole line of mountains from north to south up to an elevation of 2,000 feet above the level of the sea. It is a tree about 30 feet high, with stiff glossy leaves covered with a glaucous bloom underneath. The stem yields excellent timber, which is much prized on account of its odour.

Up to quite recent times, according to the *Chemist & Druggist*, the Japanese were denuding their camphor-tree forests, situated in the provinces of Hiogo, Satsuma, and Tosa, in as wasteful a manner as the Formosa forests are now being treated; but a wise government and a long-headed people came to see that if they were to anticipate future generations they must utilise present resources to the utmost, and by new plantations make good the old trees which have been felled. Under this enlightened policy an immense number of seedlings have been planted, and it is expected that year by year the number of trees available for felling will not diminish, so liberal have been the plantings.

The original forests still contain enormous supplies of wood; indeed, it is stated that the Government reserves alone will suffice for twenty-five years to come. The wood now used is from trees seventy to eighty years old. The tree is a most beautiful one, resembling the linden, and having a white flower which fructifies into a red berry. It attains gigantic proportions, and lives to a great age, some trees being known to be over three centuries old. The diameter of such trees is from 15 to 20 feet. In the province of Tosa there is a group of thirteen trees about a century old, which are estimated to be equal to 40,000 lbs. of crude camphor. The wood yields about 5 per cent of camphor, and the roots a larger percentage.

After the tree is felled the wood is cut into chips, which are placed in the rude boiler or still. This is provided with a false bottom, through which the steam rises, and as it passes through the wood it carries with it the camphor. The vapour is then conducted by the pipe to a condenser containing several partitions filled with cold water; in the sides of these partitions are apertures opening alternately, so that the vapour takes a circuitous route, and in the passage the camphor is deposited in crystals upon the bamboo screens. From these screens the crystals can be readily removed, and they provide an efficient means for draining off the oil. The process is an ancient one, but it is so firmly adhered to by the natives and it suits the purpose so well that there appears to be a long future for it. The annual export of camphor from Japan is about 5,000,000 lbs., three-fourths of which come to Europe.

The work of refining camphor in Japan was commenced at Kobe a few years ago by the Japan Camphor Company, an American corporation, registered under the laws of the State of New Jersey. They buy the crude camphor as it comes into the Kobe market, and then subject it to resublimation by a peculiar process devised mainly by Dr. A. G. Boyer, chemist to the company and manager of the refinery. Steel retorts are used and these are so constructed that the camphor-oil and water-vapour are conveyed to one recep-

tacle and the camphor-vapour to a cooling-chamber, where it falls as flowers of camphor. In the next stage the flowers are compressed into small and large blocks by means of powerful hydraulic presses. The pressure is such that the cakes come out beautifully clear and compact.

In the middle ages, camphor was extremely valuable. Marco Polo, when in the 13th century, he visited Fansur in the Malay Archipelago speaks of its camphor as selling for its weight in gold. Again between A.D. 1342 and 1352, an embassy left Peking bearing a letter from the great Khan to Pope Benedict XII, accompanied by presents of silk, precious stones, camphor, musk, and spices.

The camphor of the Malay Islands, however, is the product of a different tree from the native of China and Japan. (*Laurineæ*).

30. CINNAMOMUM CASSIA, *Bl.*—The Cassia Tree is a handsome tree, much like the Cinnamon Tree, with somewhat similar, small, yellowish flowers, and leaves with three strongly marked nerves. It is a native of Cochin China.

Cassia Bark is similar to Cinnamon, but thicker. It has a stronger flavour, but less delicate. It is preferred however in Germany and Russia by chocolate makers. (*Laurineæ*.)

31. CINNAMOMUM ZEYLANICUM, *Nees*.—The Cinnamon Tree though small is singularly beautiful, being one mass of shining foliage. It is a native of Ceylon, where one variety grows in the forests even up to an elevation of 8,000 feet.

Cinnamon and Cassia are spices which were known in the most remote times and were regarded as among the most costly of aromatics. The *Pharmacographia* quotes the offering made by Seleucus II., King of Syria, to the temple of Apollo at Miletus, B.C. 243, as consisting chiefly of vessels of gold and silver and olibanum, myrrh, costus, including also two pounds of cassia, and the same quantity of cinnamon. After the Portuguese had discovered the new route to India, by the Cape of Good Hope, they permanently occupied Ceylon in 1536, chiefly for the sake of the Cinnamon. Even twenty years later it was rare, if we may judge from the fact that it figures among the New Year's gifts to Philip and Mary (1556-57), and to Queen Elizabeth (1561-62).

Under cultivation the cinnamon tree is cut low down and only 4 or 5 shoots allowed to spring up. When these are about 2 years old and begin to turn brown, they are cut and the peel carefully separated into "quills." The outer bark is scraped off; and the quills, placed one inside the other, form the Cinnamon of commerce. (*Laurineæ*).

32. COCOS AUSTRALIS, *Mart.*—is a native of South Brazil. The fruit has a sweet edible pulp. (*Palmeæ*).
- 32a. COCOS BOTRYOPHORA, *Mart.* is a native of Brazil; growing along the banks of rivers in the forest. (*Palmeæ*).
33. COCOS FLEXUOSA, *Mart.* a native of Brazil, is a slender decorative palm, which can be planted in dry parts of the Island, like the *Liguanæa* plains, as it withstands drought. (*Palmeæ*.)

34. *Cocos nucifera*, Linn.—The Coco-nut Palm is considered by De Candolle to be a native of the Malay Archipelago. Its introduction into India, Ceylon, and China, he thinks, does not date further back than 3,000 years, and the transport by sea to the coasts of America and Africa took place perhaps in a more remote epoch. But, as the natives of South America have not learnt to make much use of this palm, except as a fruit, and as they are acquainted with all the various purposes to which their own truly indigenous palms may be put, it would rather seem that the Coco-nut palm is of very late introduction into the New World.

"Toddy" is obtained from the flower spathe just before it opens by slicing off the top, and collecting the sap in a vessel. It has a pleasant, sweetish taste, and in large doses is aperient; fermented it is intoxicating. It can also be boiled down into a coarse sugar called "jaggery," which is refined, or fermented and distilled into spirits.

The young Coco-nut contains a sweet refreshing water and jelly. The nut is generally harvested before it is perfectly mature. If the outer skin dries on the tree the fibre of the husk becomes coarse and dark in colour, if too young, it is weak. Coco-nut milk is made from gratings of the kernel. The shell is carved and used for many purposes. The dried kernel is known as "kopra," and is used for the preparation of oil by expression or boiling. The solid fat is employed in making candles, and the oil for cooking, for lamps, as a substitute for cod-liver oil, &c. The cake which is left, or "poonac," is a good food for cattle and is also used as a manure.

The husk of the fruit yields Coir-Fibre. "Coir is remarkable for its durability, and is used for the manufacture of various textile fabrics, brushes, cordage for the rigging of ships, nets, matting stuffing of cushions, pads and mattresses, scrubbing brushes, fishing nets, &c. The tender leaves are used for platting mats, boxes, and other fancy articles. The mature leaves are plaited into matting, and also used as materials for fences, sails, buckets, books, fans, torches and fuel. The ash yields an abundance of potash. The midribs of the leaflets are made use of as brooms, brushes, and skewers. The stalk of the spadix itself is in every day use as a chunam brush to whitewash houses with. The reticulated web of the base of the leaf forms a coarse kind of cloth. The cottony hairs are used as a styptic. The soft parts within the stem of the Coco-nut are cut out and pounded in a mortar; the resulting pulp is washed in water, and the farina is collected, and used as a substitute for sago. Aged and unfruitful trees are cut down, and the wood is turned to a variety of useful purposes; it is hard, handsome, and durable, known under the name of Porcupine Wood; it is used for veneering. The hard stem is converted into drums, gutters, water-pipes, small boats, frames, furniture, rafters for houses, spear-shafts, shingles, walking-sticks, ladies' work boxes, &c. The root stem takes a high polish so as to resemble agate. A cubic foot weighs 70 pounds, and the wood is supposed to last 50 years." (Dr. John Shortt.) A dye can be extracted from every part of the plant, producing a dirty-brown colour. Gum is said to be yielded in Tahiti.

The manufacture of butter from the Coco-nut has lately attracted some attention. The invention is due to Dr. Schlinck, a German chemist, and is of considerable importance in Europe, inasmuch as it is cheap, wholesome and perfectly digestible. The butter is a pure white transparent mass, which melts at 67° F.

As it costs only 7½d. per lb. in Germany, it at once becomes a rival to the oleomargarines which are frequently made from the diseased fat of horse and sheep flesh. It is well known that in milk many disease germs multiply fast, and are especially liable to be communicated to man from diseased animals. But Coco-nut butter does not afford a nutrient material for micro-organisms, and being a vegetable fat, there is no risk of infection. This manufactured butter is free from fatty acids, and even if left exposed to air for more than a week, does not turn rancid, except in the top layer. Owing to its high saponification degree, all adulteration is impossible. It was proved in the German Hospitals that food, even pastry, prepared with this fat was eaten without any inconvenience.

Coco-nut butter therefore meets all hygienic requirements. It is far superior to animal fat and butter, as well as to any of their other substitutes, and further, on account of its perfect digestibility, it is well adapted for the use of patients suffering from impaired digestion.

The discovery was made by Dr. Schlinck in 1885, and has been patented. A factory was started in 1888 at Mannheim, and factories were also to be opened in Paris and Amsterdam in 1890. The demand is greater than the supply. As the invention is patented no details can be obtained about the manufacture. (*Palmæ*)

35. *COCOS PLUMOSA*, *Hook.* a native of South Brazil, is, according to Von Mueller, one of the hardiest of all palms. It is quick of growth, and particularly handsome in stature. The somewhat slender stem attains a height of 60 feet. This would be a good decorative palm for the hills. (*Palmæ*.)

36. *COCOS WEDDELLIANA*, *H. Wendl.* is a native of tropical S. America. It is one of the most beautiful and elegant of palms. (*Palmæ*.)

37. *COFFEA LIBERICA*, *Hiern.*—Liberian Coffee is a native of the West Coast of Africa on lands near the sea, and the low-lying hills stretching inland, whereas common or Arabian Coffee comes originally from the highlands of Abyssinia. It is a very robust plant growing from 20 to 40 feet, and has larger flowers and berries than ordinary coffee. The flavour is considered in America, equal to the common variety, but it has not hitherto obtained as high a price in European markets.

It was first sent out from Kew to India and the Colonies, about 20 years ago, and now that special machinery has been invented to remove the tough fibrous pulp, investing the "beans", planters are taking up its cultivation with great energy. Although the character of the fruit was in this way up to the present time disadvantageous to the cultivation of the Liberian Coffee, yet now that the difficulty of machinery has been overcome, the fact that the berry does not spoil and drop from the tree after ripening, is a

distinct advantage in its favour in places where labour is scarce. The export of Coffee from Jamaica ought soon to be doubled.

This species of coffee receives its name from Liberia, a colony founded in 1823 by a philanthropical society who purchased 10,000 slaves in the United States and sent them to settle in the northern parts of Guinea. From this miniature republic, Sir Joseph Hooker introduced the new coffee. (*Rubiaceæ*)

38. *COLA ACUMINATA*, Schott & Endl.—The Kola nut or Bissy is a native of western tropical Africa. It is a tree from 30 to 60 feet high, flourishing best in moist lands from sea-level up to 1,000 feet. A full crop of 120 lbs. of nuts or seeds cannot be expected till the tree is ten years old, but in favourable situations fruit may appear after four years.

Great care is taken in Africa in the selection of nuts for sale, they are carefully picked over, and all damaged and worm-eaten are removed. The sound nuts are packed in huge baskets made of bark, lined and covered with large thick leaves. The baskets hold each 3 cwts. With the leaves on the top kept moist the nuts last well for a month, after that they are picked over again, washed and re-packed, and will last for another month; the process being repeated every month. From the country between Sierra Leone and the Congo they are carried to Gambia, where the merchants trading with the interior, purchase and dry them. It is said that by the time the nuts reach the tribes who live farthest from where they grow, they are worth their weight in gold. In Jamaica, the ripe nuts are separated into their component parts, and thoroughly dried. It is possible that the African method is the correct one.

The nuts are reputed to clarify and render healthy the most foul water, and to render tainted meat edible, and when chewed either fresh or as a dry powder and the saliva swallowed, to be a sure preventive against dysentery. They are also said to be good for the liver and to possess the property of enabling persons eating them to undergo prolonged exertion without fatigue. Dr. Neish states that the nuts furnish a nutrient and stimulant beverage, rich in the active principle of coffee containing also a large proportion of theobromine, the active principle of cacao. These nuts in addition contain three times the percentage of starch contained in chocolate, and moreover they also contain less fat, so that besides stimulant and nutritive properties, there is the probability that a chocolate prepared from them will more readily agree with delicate stomachs. What enhances the value of kola-nuts is the fact that citrate of caffeine—a medicine now much employed for the relief of sea-sickness, migrains, and other nervous complaints—can be readily obtained from these nuts, for the reason that the nuts contain more caffeine than coffee berries, and in the cola-nut the caffeine is in the free or uncombined state. See Bulletin for September, 1891. (*Sterculiaceæ*.)

39. *COLVILLEA RACEMOSA*, Baj.—is a near relation of *Poinciana regia*, and like it, is a native of Madagascar. It is a beautiful tree attaining a height of 40 or 50 feet. The leaves are about 3 feet long, deeply

divided like a fern. The flowers are scarlet and the pods 6 inches long. This tree bears the name of Sir Charles Colville, Governor of Mauritius, when Bojer discovered it in Madagascar. (*Leguminosæ*.)

40. *COPERNICIA CERIFERA*, *Mart.*—The Wax Palm of Brazil belongs to a genus of palms named after the celebrated astronomer Copernicus.

The stem is 20 to 40 feet high, adorned with the bases of the fallen leaf-stalks, arranged in beautiful spirals, and crowned by a perfect ball of fan-shaped leaves.

The leaves are coated with a glaucous bloom of wax, which is obtained by shaking the young leaves. The wax falls off in the form of a whitish scaly powder to the amount of about 50 grains from each leaf. It is exported to be made into wax candles, which retain the peculiar lemon-coloured tint of the natural product.

This palm forms immense forests, and is of great use to the Brazilians. The trunk is very durable, and is employed for the framework of houses, for cattle enclosures, and for other purposes where strength and lasting power are needed. A kind of meal is prepared from the inside of the upper portion of the stem.

The leaves are used for thatch, pack-saddles, etc., and the young leaves are given to cattle as fodder in times of scarcity.

The yellowish fruits are bitter to the taste, but are eaten, either raw or boiled, by the Indians. (*Palmeæ*.)

41. *COUROUPITA GUIANENSIS*, *Aubl.*, the Cannon Ball Tree, so-called from the size and shape of the fruit. The pulp is of a pleasant flavour, and the hard shell is used as drinking vessels.

It is a native of tropical America, and is nearly related to *Lecythis*. The flowers are large and whitish, forming clusters on the trunk and branches. (*Mylrtaceæ*)

42. *CYCAS CIRCINALIS*, *Linn.*—This singular looking plant is one of the so-called Sago Palms, but they are not Palms, and do not yield true Sago.

The stem is encased in a kind of armour, formed of the hard persistent bases of the leaves. There are no flowers in the ordinary sense of the word, but the seeds are borne on altered leaves which alternate in rings round the stem with the ordinary foliage leaves. These rings are clearly marked on this plant.

An inferior kind of flour is made by the forest tribes of India from the seeds by drying them in the sun, and then beating in a mortar. A gummy substance which exudes from the stem is used to promote suppuration. (*Cycadaceæ*.)*

43. *CYCAS REVOLUTA*, *Thunb.*—The Pine Palm of Japan grows slowly, and never reaches a greater height than 6 feet. The stem is rich in starch, which can be made into a kind of Sago, highly esteemed in Japan, and at one time it was contrary to the laws to take the plant out of the country. (*Cycadaceæ*.)

44. *DILLENTIA INDICA*, *Linn.* is a round-headed, handsome tree, 60 feet high, with hard rough leaves 8 to 10 inches long, and large showy

flowers 6 inches across with white petals, and a mass of yellow stamens in the centre. The true fruit which is about 3 inches in diameter, is composed of 20 cells, arranged round an axis, each one with several seeds enveloped in a jelly-like pulp, the whole is covered round with the calyx-leaves which have become thick and fleshy, forming a large heavy fruit 6 inches in diameter. Both fruit and leaves are used in India for making curries and jellies. The acid juice of the fruit, mixed with sugar and water, forms an excellent cooling drink in fevers, and is also useful for cough mixture. The rough leaves are employed in the same way as sand-paper for polishing. Both bark and leaves are astringent and are used medicinally. Their timber is hard and durable, especially under water. (*Dilleniaceæ*.)

45. *DIOSPYROS DISCOLOR*, Willd.—The name “Ebony” is applied to a black wood, which is hard and heavy. The Ebony of Jamaica and Cuba, (*Brya ebenus*), which is so common in the Liguanea Plains, in Clarendon, &c., is known in commerce as “Coccus Wood.”

True Ebony is heavier than water, a cubic foot weighing from 1,100 to 1,330 oz. It is close-grained and takes a high polish. It is chiefly used for inlaying and fancy work, to make piano-forte keys, &c. The best kind of Ebony is very valuable on account of its maintaining a permanent shape and not warping, it is therefore used for rules and measures. The price of the timber as imported into England varies from £5 to £20 per ton; 700 to 1000 tons are annually imported.

Wood of a high specific gravity, close-grained and black, is called Ebony, whatever the tree may be which produces it. It is however, yielded principally by species of *Diospyros*, natives of the East Indies and Tropical Africa. Amongst these species is one, *Diospyros discolor*, Willd, a native of the Phillipine Islands. This tree grows to about 40 feet high. The wood is at first of a dark flesh colour, becoming in time of an exceedingly deep black colour, very hard and compact. The reddish fruit known as Mabola, is edible, after removing the skin. The tree will probably only succeed well in Jamaica, where there is a heavy rainfall, for instance in Portland, St. Mary's and St. Thomas in the East. (*Ebenaceæ*.)

46. *DIPLOTHEMIUM CAUDESCENS*, Mart, is one of the palms which inhabit the burning sandy sea-shores of Brazil. The fruit hangs in yellow bunches, just below the silvery undersurfaces of the leaves, and the natives can easily refresh themselves with its sweet pulp, as the trunk does not attain any great height. (*Palma*.)
47. *DIPTERYX ODORATA*, Willd, is the tree which produces the Tonquin or Tonka Bean. Although this plant belongs to the same family as the common bean, the fruit is almond-like with only one seed, and is produced by a forest tree, 60 to 80 feet high, growing in the steamy atmosphere of the woods of Cayenne. When the leaves are fresh, they are fragrant with the perfume of new-mown hay. When snuff was used, a bean was commonly carried in the snuff-box for the sake of the agreeable fragrance it imparted. No great commercial importance attaches to the Tonquin Bean, only a few hun-

dred weights being imported for the extraction of the principle *coumarine*, used by perfumers as an ingredient in some fluid extracts; or they are ground for use in sachet powders. The beans are also used for placing in drawers with linen. (*Leguminosæ*.)

48. *ELLEIS GUINEENSIS*, *Jacq.*—The Oil Palm of Western Africa does not attain any great height, not more than 20 or 30 feet. The trunks are thick, and are covered with the remains of the stalks of dead leaves. Below the large tuft of prickly-stalked leaves, are to be seen the dense heads of vermillion or yellowish fruits.

The palm oil is obtained from the outer fleshy coating of the fruit, by boiling in water and skimming off the oil. It is of a bright orange-red colour, with the consistence of butter, and when quite fresh, has a pleasant odour like violets. It is exported in immense quantities for the manufacture of candles and soap. (*Palmæ*.)

49. *ELETTARIA CARDAMOMUM*, *Maton.*—The Cardamom plant is somewhat like ginger, but the flower stalks grow out horizontally close to the ground. The authors of *Pharmacographia* give an excellent description of its cultivation and uses. It grows abundantly, both wild and under cultivation, in the moist, shady mountain forests on the Malabar coast at an elevation of 2,500 to 5,000 feet above the sea. This region has a mean temperature of 72° F. and a mean rainfall of 121 inches.

The methods of cultivation, which vary in the different districts, may be thus described:—

Previous to the commencement of the rains the cultivators ascend the mountain sides, and seek in the shady evergreen forests a spot where some cardamom plants are growing. Here they make small clearings, in which the admission of light occasions the plant to develop in abundance. The cardamom plants attain 2 to 3 feet in height during the following monsoon, after which the ground is again cleared of weeds, protected with a fence and left to itself for a year. About two years after the first clearing the plants begin to flower, and five months later ripen some fruits, but a full crop is not got till at least a year after. The plants continue productive six or seven years. It is said that not more than 28 lbs can be got from an acre of forest.

Cardamoms begin to ripen in October, and the gathering continues during dry weather for two or three months. All the fruits on a scape do not become ripe at the same time, yet too generally the whole scape is gathered at once and dried—to the manifest detriment of the drug. In some plantations the cardamoms are gathered in a more reasonable fashion. As they are collected, the fruits are carried to the houses, laid out for a few days on mats, then stripped from their scapes, and the drying completed by a gentle fire-heat. In Coorg the fruit is stripped from the scape before drying, and the drying is sometimes effected wholly by sun-heat.

Cardamom seeds are an agreeable aromatic, often administered in conjunction with other medicines. As an ingredient in curry powder, they have also some use as a condiment. But the con-

sumption in England is small in comparison with what it is in Russia, Sweden, Norway and parts of Germany, where they are constantly employed as a spice for the flavouring of cakes. (*Scitamineæ*.)

50. *ENTADA SCANDENS*, *Benth.*—The bower by the river is formed by this climbing plant, the Cacaoon, with a thick, twisted stem, and branches which have covered all the neighbouring trees. This is a native plant. It has a very large pod, often 3 feet long, and beans of corresponding size. The beans are sometimes picked up on the shores of the Orkney Islands, carried thither by the Gulf Stream. Long before Columbus was born, they conveyed a message to the Old World, that a land of woods and streams was waiting to welcome to its hospitable shores any and all who were willing to take advantage of the prodigal gifts of Nature, and make use of them for the benefit of mankind. (*Leguminosæ*.)

51. *ERYTHRINA UMBROSA* *H. B. & K.*, is the tree that is generally used in Trinidad as shade for Cocoa. Charles Kingsley, in his enthusiastic way, thus speaks of it in his account of a Cocoa plantation :—

“Our path lay through the first Cacao plantation I had ever seen, though, I am happy to say, not the last by many a one.

“Imagine an orchard of nut-trees, with very large, long leaves. Each tree is trained to a single stem. Among them, especially near the path, grow plants of the common hothouse *Datura*, its long white flowers perfuming all the air. They have been planted as landmarks, to prevent the young Cacao trees being cut over when the weeds are cleared. Among them, too, at some twenty yards apart, are the stems of a tree looking much like an ash, save that it is inclined to throw out broad spurs like a *Ceiba*. You look up, and see that they are *Bois immortelles*, fifty or sixty feet high, one blaze of vermillion against the blue sky. Those who have stood under a Lombardy poplar in early spring, and looked up at its buds and twigs, showing like pink coral against the blue sky, and have felt the beauty of the sight can imagine faintly—but only faintly—the beauty of these “*Madres de Cacao*,” Cacao-mothers, as they call them here, because their shade is supposed to shelter the Cacao trees, while the dew collected by their leaves keeps the ground below always damp.

“I turned my dazzled eyes down again, and looked into the delicious darkness under the bushes. The ground was brown with fallen leaves, or green with ferns ; and here and there a slant ray of sunlight pierced through the shade, and flashed on the brown leaves, and on a grey stem, and on a crimson jewel which hung on the stem—and there, again, on a bright orange one ; and as my eye became accustomed to the darkness, I saw that the stems and larger boughs, far away into the wood, were dotted with pods, crimson or yellow or green, of the size and shape of a small hand closed with the fingers straight out. They were the Cacao pods full of what are called at home cocoa-nibs. And there lay a heap of them looking like a heap of gay flowers ; and by them sat their brown owner, picking them to pieces and laying the seeds to dry on a cloth. I went up and told him that I came from England, and never saw Cacao before, though I had been eating and drinking

it all my life; at which news he grinned amusement till his white teeth and eyeballs made a light in that dark place, and offered me a fresh broken pod that I might taste the pink, sour-sweet pulp in which the rows of nibs lie packed, a pulp which I found very pleasant and refreshing.

"He dries his Cacao-nibs in the sun, and, if he be a well-to-do and careful man, on a stage with wheels, which can be run into a little shed on the slightest shower of rain; picks them over and over, separating the better quality from the worse; and at last sends them down on mule-back to the sea, to be sold in London as Trinidad cocoa, or perhaps sold in Paris to the chocolate makers, who convert them into Chocolate Menier or other, by mixing them with sugar and vanilla." (*Leguminosæ*.)

52. *ERYTHROXYLON COCA*, *Lam.*—is the plant which yields the well-known Cocaine. Mr. Clements Markham gives the following description from his own observations:—"The coca-leaf is the great source of comfort and enjoyment to the Peruvian Indian; it is to him what betel is to the Hindu, kava to the South Sea Islander, and tobacco to the rest of mankind; but its use produces invigorating effects which are not possessed by the other stimulants. From the most ancient times the Peruvians have used this beloved leaf, and they still look upon it with feelings of superstitious veneration. In the times of the Incas it was sacrificed to the Sun, the Huillac Umu or high priest chewing the leaf during the ceremony, and, before the arrival of the Spaniards, it was used, as the cacao in Mexico, instead of money.

"The coca plant is cultivated between 5,000 and 6,000 feet above the level of the sea, in the warm valleys of the eastern slopes of the Andes, where almost the only variation of climate is from wet to dry, where frost is unknown, and where it rains more or less every month in the year. It is a shrub from four to six feet high, with lichens usually growing on the older trunks.

"No Indian is without his *chuspa* or coca-bag, made of llama-cloth dyed red and blue in patterns, with woollen tassels hanging from it. He carries it over one shoulder, suspended at his side; and, in taking coca, he sits down, puts his *chuspa* before him, and places the leaves in his mouth one by one, chewing and turning them till he forms a ball. He then applies a small quantity of carbonate of potash, prepared by burning the stalk of the quinoa plant, and mixing the ashes with lime and water, thus forming cakes which are dried for use, and also kept in the *chuspa*. They usually perform this operation three times in a day's work, and every Indian consumes two or three ounces of coca daily.

"In the mines of the cold region of the Andes the Indians derive great enjoyment from the use of coca; the running *chasqui*, or messenger in his long journeys over the mountains and deserts, and the shepherd watching his flock on the lofty plains, has no other nourishment than is afforded by his *chuspa* of coca, and a little maize. The smell of the leaf is agreeable and aromatic, and when chewed it gives out a grateful fragrance, accompanied by a slight irritation which excites the saliva. Its properties are to enable a

greater amount of fatigue to be borne with less nourishment, and to prevent the occurrence of difficulty of respiration in ascending steep mountain sides. Tea made from the leaves has much the taste of green tea, and if taken at night, is much more effectual in keeping people awake. Applied externally, coca moderates the rheumatic pains caused by cold, and cures headaches. When used to excess it is, like everything else, prejudicial to the health, yet, of all the narcotics used by man, coca is the least injurious, and the most soothing and invigorating.

"I chewed coca, not constantly, but very frequently, from the day of my departure from Sandia, and, besides the agreeable soothing feeling it produced, I found that I could endure long abstinence from food with less inconvenience than I should otherwise have felt, and it enabled me to ascend precipitous mountain sides with a feeling of lightness and elasticity, and without losing breath. This latter quality ought to recommend its use to members of the Alpine Club, and to walking tourists in general, though the sea voyage probably causes the leaves to lose much of their virtue. To the Peruvian Indian, however, who can procure it within a few weeks of its being picked, the coca is a solace which is easily procured, which affords great enjoyment, and which has a most beneficial effect." (*Linaceæ*).

53. *EUCALYPTUS CITRIODORA*, *Hook.*—Eucalyptus trees have obtained a reputation for destroying the germs of malaria in districts where fever is prevalent.

The Campagna of Rome is extremely unhealthy in summer owing to malaria, but an interesting experiment with Eucalyptus has proved the value of this tree and shown that the reputation it has earned is well deserved. About two miles from Rome is the convent of Tre Fontane, commemorating the martyrdom of St. Paul. A few years ago, the convent was always abandoned by the monks during the summer months as it was impossible to live there in the malarial season. Now, however, since Eucalyptus trees have been planted all round the convent, the monks remain throughout the year.

The destruction of the fever germs is due to the fact that the leaves contain a volatile oil and a volatile acid which are given off into the surrounding air, and by combination with oxygen are changed into peroxide of hydrogen. Germs passing through such an atmosphere are invariably killed. While the Eucalyptus oil is oxidising there appears to be an action going on by which oxygen is changed into the very active and healthful ozone.

Mr. Bosisto, whose extensive works for the manufacture of Eucalyptus oil in Australia are famous, wrote on the subject nearly twenty years ago, giving results which he had obtained by experiment, not in a chemical laboratory only, but by dealing with four tons of material daily for about twenty years. He showed not only in what way the leaves acted, but pointed also to the very powerful root action which absorbs immense quantities of water from swampy soils. The roots thereby to a great extent drain swampy land and their absorbent powers are assisted by the very abundant

leaf-surface which enables the tree to pass the water off into the atmosphere as healthy vapour. This draining action is in itself of immense service in preventing the possibility of the malarial germs finding a suitable soil. Australia possesses in a very high degree an immunity from fever maladies, the fevers of the large towns being due to insanitary conditions.

Dr. Day of Geelong recommended, according to Mr. Bosisto, as an excellent and very agreeable disinfectant, deal saw-dust mixed in the proportion of about one ounce of Eucalyptus oil to the bushel; and remarked that after keeping it mixed for four months, he found it to contain a much larger quantity of peroxide of hydrogen than it did when first mixed and that it continued to accumulate.

There are numerous species of Eucalyptus in Australia (of which country it is a native) adapted to various conditions of climate, soil, elevation, &c. (*Myrtaceæ*).

54. *EUGENIA CARYOPHYLLATA*, *Thunb.*—The Clove Tree is 30 or 40 feet high when full-grown. The cloves of commerce are the unexpanded flower-buds, of which great numbers are produced. The average weight of cloves produced by a tree in Amboyna, is 2 or 2½ lbs., and as it takes about 5,000 cloves to make a pound, each tree will have 10,000 to 12,000 flowers and that twice in a year.

One of the original trees planted by the French in Mauritius yielded in some years 125 lbs. of spice and there must have been more than 600,000 flowers on this single tree during the year, "a fact," says Bory de St. Vincent, "which would appear incredible, were we not to mention that this beautiful tree is at least 40 feet high, throwing out innumerable branches, some of which falling down on all sides, form a pyramid of verdure."

At the end of the year the tree is covered with its lovely crimson buds shown off by the background of dark green leaves. The buds are picked by hand as soon as they turn crimson and before opening. They are then dried in the sun.

The form of the dried buds somewhat resembles a nail; the French call the spice *Clou*, the Spanish *Clavo*, whence the English name *Clove*.

The tree begins to flower at the age of six years, yields the largest crops at 12, and does not last longer than 20 years.

The spice appears to have come into use in Europe after the Portuguese, in the year 1511, discovered the Moluccas, where it is a native. When the Dutch seized the Spice Islands, they tried to restrict the cultivation, but the French introduced the tree into Mauritius in 1769, and from that island into Cayenne 10 years later. At later periods they planted it in Hayti, Dominica, St. Kitts, Martinique and St. Vincent. It was first planted in Jamaica in 1789 by Dr. Thomas Clarke, Island Botanist, who obtained it from Port-au-Prince.

Cloves have been supplied commercially almost wholly from the island of Zanzibar. But with the abolition of slavery there, the exports will fall off very considerably, and the supply must come from elsewhere. (*Myrtaceæ*).

55. *EUGENIA MALACCENSIS*, Linn.—The Otaheite or Malay Apple is a very beautiful tree, especially when in flower. The scarlet tassels of long stamens drop gradually as the flower expands, and carpet the ground with brilliant colouring. The fruit is the size of an apple, and is juicy though rather insipid; it is wholesome and is used especially for stews. (*Myrtaceæ*.)

56. *GARCINIA MANGOSTANA*, Linn.—The celebrated Mangosteen is represented by two trees in the garden. One of these yielded a fairly large crop in the year 1891, but usually there are only a few fruits produced. Dr. Roxburgh, in his *Flora Indica* written about 70 years ago says:—"From the earliest accounts we have of this charming tree and its delicious fruit, we learn that all the innumerable attempts hitherto made to familiarise it to other countries (than the Malay Peninsula and islands to the eastward of the Bay of Bengal) have uniformly proved unsuccessful. For these 35 years past I have laboured in vain to make it grow and be fruitful on the continent of India. The plant has always become sickly when removed to the north or west of the Bay of Bengal, and rarely rises beyond the height of 2 or 3 feet before it perishes." It fruits, however, in Ceylon. Firminger, writing 50 years later, states that "the cultivation of the Mangosteen in the open air, at least as high north as any part of Bengal, seems now pretty well decided to be impracticable. Plants have been repeatedly introduced into the gardens about Calcutta, but have never been known to yield fruit."

It is therefore very satisfactory to find that it has been successfully grown in Jamaica. The tree grows to a height of 30 or 40 feet, with simple elliptical pointed leaves, and dull-red flowers about the size of a wild rose.

Dr. Abel, writing of the fruits of Batavia, says:—"First in beauty and flavour, was the celebrated Mangosteen. This, which has been so often eulogized by travellers, certainly merits much of the praise that has been lavished upon it. It is of a spherical form, of the size of a small orange. . . . Its succulent rind is nearly the fourth of an inch in thickness. It contains a very powerful astringent juice, and in wet weather exudes a yellow gum, which is a variety of gamboge. On removing the rind its esculent substance appears in the form of a juicy pulp, having the whiteness and solubility of snow, and a refreshing, delicate, delicious flavour. To define it by more precise language, is very difficult. We were all anxious to carry away with us some precise expression of its qualities but after satisfying ourselves that it partook of the compound taste of the pine-apple and peach, we were obliged to confess that it had many other equally good, but utterly inexpressible, flavours." (*Guttiferae*.)

GARCINIA MORELLA, Desrouss.—The Gamboge tree grows most luxuriantly in dense jungles of Cambodia. After the rainy season is over, the gamboge-collectors start for the forest in search of the trees which in some localities are plentiful. Having found one of the full size, they make a spiral incision in the bark round half

the circumference of the trunk, and tie below the cut a joint of bamboo to receive the sap which slowly exudes for some time. When it first issues from the tree, it is a yellowish fluid, which after passing through a viscid state hardens into the gamboge of commerce. Each tree yields on an average in one season enough to fill 3 joints of bamboo $1\frac{1}{2}$ inches in diameter. The tree appears to suffer no injury provided the tapping is not more frequent than every other year. When the bamboo joints are full, after from 15 to 30 days, they are gradually rotated over a fire, until the gamboge is hard enough to allow of the bamboo being stripped off. In Europe, gamboge is chiefly used for water-colour drawings; in Burma it is employed to dye silks; and by Hindus in Mysore as a pigment in making caste marks on the forehead. It is used medicinally in India in combination with other purgatives. The timber is recommended for cabinet-work. (*Guttiferae*)

58. *GLORIOSA SUPERBA*, Linn. is a very pretty climbing plant with strange looking flowers of a deep rich orange and red colour. It is a native of tropical Asia and Africa, and was introduced into England about 200 years ago. It belongs to the same family as the Lily, but in outward habit and appearance, is very different. The recurved, erect petals were likened by Linnaeus to flames. The leaves are remarkable in having their elongated tips modified into tendrils. (*Liliaceae*.)

59. *GORDONIA ANOMALA*, Spreng.—This is a handsome shrub with large white flowers, nearly related to the cultivated Camellia and to the Tea Plant. It is a native of Hong Kong, and flowers both at Castleton and at the Hill Garden at an elevation of 5,000 ft. (*Ternstroemiaceae*.)

60. *GYNOCARDIA ODORATA*, R. Br.—This tree, a native of north-east India, yields the Chaalmugra Oil, which is expressed from the seeds. The oil has long been used by the natives of India for cutaneous diseases. During the past few years it has become of some importance as a drug in Europe, and is recommended as a remedy for leprosy, psoriasis, eczema, scrofula, phthisis, lupus, marasmus, chronic rheumatism, and gout. It is employed both internally and externally. (*Bixineae*)

61. *HEVEA BRASILIENSIS*, Muell. Arg.—The best Rubber is obtained from these trees, and as the province of Para in Brazil is the chief source of it, the name applied to it in commerce is Para Rubber.

The trees are 60 feet high before rubber is collected from them. The mode of collecting is to make deep gashes into the bark, and stick cups of clay beneath the incisions to catch the milky juice. Coagulation of the rubber from the milk is effected by heating thin layers of it on a paddle-shaped mould over the hot smoke of a fire made of palm nuts. When a sufficient thickness has been obtained, the rubber is cut and taken off the mould.

62. *HEVEA SPRUCEANA*, *Muell. Arg.*—This is one of the trees that yield Para Rubber.

The scene presented by an encampment of caoutchouc collectors is described by Clements Markham as extremely picturesque. Their huts are lightly built among the trees, and round them tower the majestic *mosqueteiro* palms and the lofty *Bertholletia* (yielding Brazilnuts), while in front is the gleaming river with its sunny sandbanks. From the huts narrow paths lead through the dense undergrowth, cut by the axe of the *seringueiro*, to the lonely caoutchouc trees. The collector makes small holes in the bark, to which tubes of clay are fixed, which lead the milk into bamboo receptacles; going from tree to tree he collects these bamboos, and on his return to the hut the contents are poured into the carapace of a large tortoise. The milk is then subjected to the process of smoking without delay, for if left standing too long the resin separates. In this process the milk is subjected to the smoke of the *urucuy* or nuts of the *Attalea excelsa* palm. An iron pot without a bottom, and with a narrow neck like a bottle, is placed so as to form a chimney over a heap of these burning nuts, and the white steam rises in masses through the narrow opening. The *seringueiro* pours a small quantity of the white fluid, of the consistency of thick milk, from a calabash over a light wooden shovel, as evenly as possible, and then rapidly thrusts it into the white steam. The milk soon takes a greyish-yellow colour, and becomes firm. Then they add layer upon layer, until the caoutchouc on each side of the shovel is about 8 inches thick. The *plancha* or slab is then finished, taken off the shovel by cutting down one side, and hung up in the sun to dry, as there is a good deal of water between the layers. (*Euphorbiacee.*)

63. *HIBISCUS ELATUS*, *Sw.*—(the Mountain Mahoe) a native of Jamaica and Cuba, reaches a height of 50 to 60 feet. The timber is valuable, especially to cabinet-makers; it has the appearance of dark-green variegated marble. The fibres of the bark make good ropes. The lace-like inner bark was at one time known as Cuba bark, from its being used as the material for tying round bundles of Havana cigars. (*Malvacee.*)
64. *HIPPOMNÆ MANCINELLA*, *Linn.*—The Manchineel tree has acquired as bad a reputation as the Upas tree for its poisonous and hurtful properties. There is no doubt that its milky juice is very acrid, causing temporary blindness if it gets into the eyes, and some persons suffer great pain from incautiously touching it. (*Euphorbiacee.*)
65. *ILEX PARAGUENSIS*, *A. St. Hil.*—The Paraguay Tea tree, a native of Paraguay, is for South America what the tea shrub is to the rest of the world. The leaves contain the same principle as tea, and are used for the same purposes, but they are not subjected to such elaborate preparation. The branches are simply placed on hurdles over a wood fire, and when sufficiently roasted, they are knocked off and powdered. The powdered leaves are put into a calabash, called a *maté*, boiling water poured on, and used at once before turning black and bitter. The drink is also called *maté*. It is passed round the company,

and each one has his own tube, or "bombilla," which is inserted into the mate to suck up the refreshing beverage. A small wire cage at the end of the bombilla prevents the dust from entering the tube. (*Ilicineæ*.)

66. *LAGERSTROEMIA FLOSH REGINAE, Retz.*—(Queen's Flower), when in blossom, is one of the most showy trees of the Indian forests. A moist, damp climate is most suitable for its growth and for the full development of its rose-coloured blossoms. It reaches a height of 50 feet. The timber is blood-red, and as it lasts well in water, it is used for boat-building. In Burmah, it is employed more than any other timber except teak, for a variety of purposes, but it soon decays under ground. The astringent roots have been used as a remedy for thrush; the bark and leaves are purgative. (*Lythraceæ*.)
67. *LECYNTHIS ZABUCAJO, Aubl.*—Sapucaia nuts, the seeds of this tree are nearly allied to the common Brazil nuts, but they have a better flavour. They have a corky shell, and are enclosed in a large urn-shaped seed-vessel about 6 inches across with a lid at the top. When the seeds are ripe the lid falls away, and the seeds are scattered; whereas, the seed-vessel of the Brazil nuts (*Bertholletia*) has no lid, and must be broken open with an axe to get at the nuts. The trees grow to a height of 80 feet in their native forests in Brazil. (*Myrtaceæ*.)
68. *LICUALA PELTATA, Roxb.*—The "Chattah-pat" palm of the people of Assam has large round leaves which are used by the natives to make their "chattah" or umbrella hat. (*Palmeæ*.)
69. *LIVISTONA AUSTRALIS, Mart.*—This is one of the few palms indigenous to Australia, where it attains a height of 80 or 100 feet. It has large fan-shaped leaves, which in the unexpanded condition are made into hats after preparation by scalding and then drying in the shade. The "cabbage" is used as food in the same way as that of the Cabbage Palm in the West Indies.
- The history of the introduction of this Palm from Australia is interesting, as related by Seemann. The number of Palms grown in gardens was at one time very limited, chiefly owing to the great difficulty experienced in transmitting the seed to Europe without its losing the germinating power. This difficulty was however, at last overcome. When Allan Cunningham, the botanist, was in Australia, he sent a case with living plants to the Royal Gardens at Kew, which on being disturbed was found to have, instead of the crocks usually placed at the bottom of such cases for drainage, seeds of a Palm, nearly all in process of germination. Cunningham's attendants too indolent to look for the crocks, had substituted the seeds of the *Livistonia australis*, which happened to be more handy. These young plants were carefully nursed, and one of them became one of the gems of the collection of Palms at Kew. It at last reached the roof of the Palm House, and had to be removed. The discovery that the seeds of Palms could be introduced most effectually by being in their native country at once

placed in mould was not overlooked at Kew, and to the diffusion of the knowledge of this fact must be mainly ascribed the great increase of the collections of Palms in horticultural establishments.

As this Palm endures the winters of the south of France, it would doubtless be suitable for ornamental purposes in the higher elevations of Jamaica. (*Palmeæ*.)

70. *LIVISTONA CHIMENSIS*, *R. Br.*, is a decorative Fan Palm, which will suit the higher elevations of the island. In its native country, China and Japan, the hairy stem-covering is used for fixing lime plaster to buildings. (*Palmeæ*.)
71. *LONGHOCARPUS CYANESCENS*, *Benth.*—The Yoruba Indigo of west tropical Africa is used in its native country to produce a deep blue, very permanent when fixed with potash. The leaves are gathered young, powdered in a mortar into a black pasty state, made into balls the size of two fists, and then dried. In dyeing, one ball is used to a gallon of water, and the cloth is left four days in the dye. (*Leguminosæ*.)
72. *MANICARIA SACCIFERA*, *Gaertn.*—The Bussu Palm of the tidal swamps of the Amazon, has a stem from 10 to 15 feet high, and leaves often 30 feet long and 4 or 5 feet wide. The rigid leaves which are the largest undivided leaves of any palm, form an excellent thatch, lasting for 10 or 12 years. "An Indian will often take a week's voyage in order to get a canoe-load of the leaves to cover his house. The spathe, too is much valued by the Indian, furnishing him with an excellent and durable cloth." Taken off entire, it forms bags in which he keeps the red paint for his toilet or the silk cotton for his arrows, or he even stretches out the larger ones to make himself a cap, cunningly woven by nature without seam or joining. When cut open longitudinally and pressed flat, it is used to preserve his delicate feather ornaments and gala dresses, which are kept in a chest of plaited palm leaves, between layers of the smooth 'bussu' cloth."—(A. R. Wallace.) (*Palmeæ*.)
73. *MANIHOT GLAZIOVII*, *Muell. Arg.*—Ceara Rubber is yielded by this tree, a native of a dry arid region in Brazil, where it is obtained by paring off the outer surface of the bark to a height of 5 feet. The milky juice exudes slowly, and after some days it is pulled off in strings and rolled up into balls. (*Euphorbiaceæ*.)
74. *MARANTA ARUNDINACEA*, *Linn.*—Arrowroot is the name given to the starch extracted from the tuberous roots of certain plants. In Jamaica, there are two plants used for the purpose, *Maranta arundinacea* and *Canna edulis*, which latter is sometimes called "Spanish Arrowroot."
Maranta belongs to the ginger family and has yellowish-white flowers. *Canna* is one of the plants often known as "Indian Shot," and has red flowers. Shoots are taken from the old roots, and planted, during May, in holes about 2 feet apart every way. When the leaves fade, in about a year's time from planting, the roots are dried, and carefully washed. The outer skin is removed

and the roots again washed. The roots are then grated, or pounded in wooden mortars, or crushed between rollers. The pulp is put into clear water, and very thoroughly mixed up by stirring. This process separates the starch grains from the fibrous portion which is removed by straining through sieves of progressive fineness. The water containing the starch grains, is allowed to settle, when the water is run off. To obtain the finest article, the washings are repeated several times, and all contamination avoided with dust, &c., or even iron in the water. The starch is dried on calico trays in the sun, and packed in cases as soon as possible. The fibrous refuse is good feeding for pigs. About 100 lbs. of arrow-root may be obtained from 4 barrels of cleaned roots; and from 25 to 30 barrels from the acre. (*Scitamineæ*.)

75. *MAURITIA FLEXUOSA*, Linn. f.—The *Æta* Palm. Charles Kingsley, in his very interesting book, “At Last,” speaks of this palm, as he saw it growing in the forests of Trinidad:—

“The forest ended, and a scene opened before us which made me understand the admiration which Humboldt and other travellers have expressed at the far vaster savannas of the Oroonoco.

“A large sheet of grey-green grass, bordered by the forest wall, as far as the eye could see, and dotted with low bushes, weltered in mirage; while stretching out into it, some half a mile off, a grey promontory into a green sea,—was an object which filled me with more awe and admiration than any thing which I had seen in the Island.

“It was a wood of Moriche palms; like a Greek temple, many hundred yards in length, and, as I guessed, nearly a hundred feet in height; and like a Greek temple, ending abruptly at its full height. The grey columns, perfectly straight and parallel, supported a dark roof of leaves, grey underneath, and reflecting above from their broad fans, sheets of pale glittering light. Such serenity of grandeur I never saw in any group of trees; and when we rode up to it and tethered our horses in its shade, it seemed to me almost irreverent not to kneel and worship in that temple not made with hands.

“The short, smooth columns of the Moriches towered around us till, as we looked through the “pillared shade,” the eye was lost in the green abysses of the forest. Overhead, their great fan leaves form a groined roof, compared with which that of St. Mary Redcliff, or even of King’s College, is as clumsy as all man’s works are beside the works of God..... •

“The noble Moriche palm delights in wet, at least in Trinidad, and on the lower Oroonoco, but Schomburgk describes forests of them—if indeed, it be the same species—as growing in the mountains of Guiana up to an altitude of four thousand feet. The soil in which they grow here is half pitch pavement, half loose brown earth, and over both, shallow pools of water, which will become much deeper in the wet season; and all about float or lie their pretty fruit, the size of an apple, and scaled like a fir-cone. They are last year’s, empty and decayed. The ripe fruit contains first a rich, pulpy nut, and at last a hard cone, something like that of the

vegetable ivory palm. Delicious they are, and precious, to monkeys and parrots, as well as to the Oroonoco Indians, among whom the the Tamanacs, according to Humboldt, say, that when a man and woman survived that great deluge, which the Mexicans call the age of water, they cast behind them, over their heads, the fruits of the Moriche palm, as Deucalion and Pyrrha cast stones, and saw the seeds in them produce men and women, who re-peopled the earth. No wonder, indeed, that certain tribes look on this tree as sacred, or that the missionaries should have named it the tree of life."

Humboldt describes them thus :—"In the season of inundations these clumps of *Mauritia*, with their leaves in the form of a fan, have the appearance of a forest rising from the bosom of the waters. The navigator in proceeding along the channels of the delta of the Oroonoco at night, sees with surprise the summit of the palm-trees illumined by large fires. These are the habitations of the Guaraons, which are suspended from the trunks of the trees. These tribes hang up mats in the air, which they fill with earth, and kindle on a layer of moist clay the fire necessary for their household wants. They have owed their liberty and their political independence for ages to the quaking and swampy soil, which they pass over in the time of drought, and on which they alone know how to walk in security to their solitude in the delta of the Oroonoco, to their abode on the trees. The *Mauritia* palm-tree, the tree of life of the missionaries, not only affords the Guaraons a safe dwelling during the risings of the Oroonoco, but its shelly fruit, its farinaceous pith, its juice abounding in saccharine matter, and the fibres of its leaf stalks, furnish them with food, wine, and thread proper for making cords and weaving hammocks. It is curious to observe in the lowest degree of human civilization the existence of a whole tribe depending on one single species of palm-tree, similar to those insects which feed on one and the same flower or on one and the same part of a plant."

A. R. Wallace goes into more detail as regards the uses of this palm :—"The leaves, fruit and stem of this tree are all useful to the natives of the interior. The leaf-stalks are applied to the same purposes as the Jupati, (*Raphia tediigera*). The epidermis of the leaves furnishes the material of which the string for hammocks, and cordage for a variety of purposes, is made. The unopened leaves form a thick pointed column rising from the very centre of the crown of foliage. This is cut down, and by a little shaking the tender leaflets fall apart. Each one is then skilfully stripped of its outer covering, a thin riband-like pellicle of a pale yellow colour which shrivels up almost into a thread. These are then tied in bundles and dried and are afterwards twisted by rolling on the breast or thigh into string, or with the fingers into thicker cords. The article most commonly made from it is the "réde," or netted hammock, which is the almost universal bed of the native tribes of the Amazon. These are formed by doubling the string over two rods or poles about six or seven feet apart, till there are forty or fifty parallel threads, which are then secured at intervals of about a foot by cross strings twisted and tied on to every longitudinal

one. A strong cord is then passed through the loop formed by all the strings brought together at each end, by which the hammock is hung up a few feet from the ground and in this open net the naked Indian sleeps beside his fire as comfortably as we do in our beds of down.

"Other tribes twist the strings together in a complicated manner so that the hammock is more elastic, and the Brazilians have introduced a variety of improvements by using a kind of knitting needle producing a closer web, or by a large wooden frame with rollers, on which they weave in a rude manner with a woof and weft as in a regular loom. They also dye the string of many brilliant colours which they work in symmetrical patterns, making the rédes or "maqueiras" as they are there called, among the gayest articles of furniture to be seen in a Brazilian house on the Amazon.

"From the fruits a favourite Indian beverage is produced. They are soaked in water till they begin to ferment, and the scales and pulpy matter soften and can be easily rubbed off in water. When strained through a sieve, it is ready for use, and has a slight acid taste and a peculiar flavour of the fruit at first rather disagreeable to European palates." (*Palmae*.)

76. *MAXIMILIANA MARTIANA*, *Karst.*—This Palm, when full grown, has a lofty stem with leaves 50 feet long. The large woody spathes which cover the young flowering branch, are used as baskets, cradles, and even to boil meat in. It grows in the drier forests of Brazil. (*Palmae*.)

77. *MESUA FERREA*, *Linn.*—The Naghas tree of the Hindoos is everywhere cultivated in India for the beauty and fragrance of the flowers, the delicate colouring of the young leaves and the excellent shade afforded by the leafy branches. The flowers are dried, and used for *sachets*; and also in medicinal preparations, as they are astringent and stomachic, besides imparting a perfume. The oil expressed from the dried kernel of the seeds is applied as an embrocation for rheumatism, etc. The wood is one of the Iron Woods, extremely hard, heavy, and difficult to work, and proof against white ants. The Hindoo legend tells how one of the five arrows of Kamadeva, the Indian Cupid, is tipped with the wood of the Naghas. (*Guttiferae*.)

78. *MICHELIA CHAMPACA*, *Linn.*—The Champac Tree is a native of India, and is commonly cultivated throughout that country. It is sacred to Vishnu, and is therefore planted near Hindu temples, the sweet scented flowers being offered at the shrines.

The timber can be used for furniture and building, and the bark is bitter and aromatic.

Medicinally, the flowers are said to be the cheapest, commonest, and most useful drug in India, prescribed in dyspepsia, nausea, and fever. They are of a yellow colour and are used by the native women to adorn their dark hair.

The exquisite perfume of the flowers is alluded to by Shelley :—

“ The wandering airs they faint
On the dark, the silent stream—
The Champac odours fall
Like sweet thoughts in a dream.”

—(*Magnoliaceæ*.)

79. *MUSA TEXTILIS*, *Née*.—Manilla Hemp is prepared from this plant, the Abaca of the Philippine Islands. It is very much like the banana and plantain, but the fruit is not edible. It is the most important of all cordage fibres, about 50,000 tons being imported annually to Great Britain and the United States. Royle says that the Abaca is cut when about one year and a half old, just before its flowering or fructification is likely to appear, as afterwards the fibres are said to be weaker. If cut earlier the fibres are said to be shorter and finer. It is cut near its roots, and the leaves cut off just below their expansion. It is then slit open longitudinally, and the central peduncle separated from the sheathing layers of fibres, which are in fact the petioles of the leaves; of these layers the outer are harder and stronger, and form the kind of fibre called *bandala* which is employed in the fabrication of cordage. The inner layers consist of finer fibres and yield what is called *lupis* and used for weaving *nipis* and other more delicate fibres; while the intermediate layers are converted into what is called *tupos*, of which are made web-cloths and gauzes, 4 yards long, of different degrees of fineness. These are universally used as clothing; some being so fine that a garment can be enclosed in the hollow of the hand. (*Musaceæ*.)

80. *MYRISTICA FRAGRANS*, *Houtt.*—The nutmeg has not been hitherto cultivated to any extent in Jamaica, but as over 30,000 plants have been distributed from the gardens during the past few years to various parts of the island, it is hoped that the foundations are being laid for building up a lucrative trade.

The most famous nutmeg gardens in the world are in Banda, one of the Spice Islands of the East Indies. Mr. H. O. Forbes, in his “Naturalist’s Wanderings,” gives an interesting picture of Banda and its nutmeg groves.

“A sail of two nights and a day brought us to Banda. We found ourselves slowly steaming in through a narrow winding entrance between thickly foliaged cliffs, which seemed, after giving us passage, to glide together and enclose us within a deep blue inland lake without entrance or exit. It was the most lovely spot we had yet visited. Fronting us as the steamer warped itself to the jetty, lay the town as a cluster of white houses, built along the low, narrow foreshore, overshadowed on all sides by steep heights densely wooded with bright green vegetation.

“We walked through the town, and wandering up the heights by a path overgrown with lycopods and ferns, we presently found ourselves under a delightfully shady canopy of tall kanary trees, and among the groves of nutmeg of which Banda is the famous garden. Quite a picturesque object in the wood was a

boy busy gathering the fruit into a neat creel with a jointed pole like a fishing rod, nipping off the stalk of the ripe nuts by two claw-like prongs with which the tip of his rod was armed, when they dropped into a little basket-like cage worked to the stem a few inches below. He came and showed us his basket full of beautiful fruit in its pale yellow shell, half of which is left on, in which was nestling the dark brown nut embroidered with its deep lake mace.

"Further on we came on one of the plantation houses, where a large number of men and women were peeling the mace, drying it in the sun, and packing both in boxes. These cases are all made of one size, carefully finished and caulked, and form as delightful an article of cargo as could be wished. None but a trade *de luxe* would befit an island so ornate and so wonderfully situated as Banda. Its produce, grown in beautiful bowers, is gathered up round its umbrageous shores in long gaudily-painted canoes, and in whose preparation or shipment not one hand-soiling operation is required; its atmosphere is charged with aromatic exhalations, its wharfs and streets are the picture of tidiness, and the very water that laps its coral shores is brighter and purer than almost anywhere else in the world." (*Myristicæ*.)

81. MYROXYLON PEREIRÆ, *Klotzsch*.—The Balsam of Peru is obtained from this tree, a native of Salvador in Central America. After the rains the trunk of the tree is beaten on four sides with some blunt instrument until the bark is loosened, leaving four intermediate strips untouched in order to preserve the life of the tree. Six days afterwards lighted torches are applied to the injured bark to promote an abundant flow of balsam. After seven or eight days more the charred bark is removed. Rags are then placed on the wood, taken away as they become saturated with the balsam, and boiled in water until the balsam sinks to the bottom, the impurities being skimmed off. The second year the balsam is obtained from the bark previously untouched. The bark is renewed in two years, so that a tree yields a constant supply. The balsam possesses stimulant and expectorant properties. (*Leguminosæ*).
82. MYROXYLON TOLUIFERUM, *H. B. & K*.—The Balsam of Tolu possesses similar properties to those of the Balsam of Peru. The tree from which it is extracted grows to a height of 80 feet, nearly double that of the other balsam tree. It is a native of New Grenada. The mode of collecting is to make V-shaped cuts in the bark to the wood, when the balsam exudes and collects in a calabash placed at the bottom of the cut. The collection goes on from July to March. (*Leguminosæ*.)
83. NAPOLEONA IMPERIALIS, *Beauv.*.—This is a small tree, native of western tropical Africa. The structure of the flower is interesting. The corolla consists of three rows: the outer is of a rich claret colour with a cream or apricot-coloured margin; it is divided into 5 lobes, each lobe with 6 or 7 ribs, spreading from the base like a

fan; as it expands, it bends outwards, concealing the calyx. The next row is somewhat like the "crown" of the passion flower, consisting of a number of whitish threads tipped with pink. The third and innermost row is cup-shaped with the margin bent inwards and divided into numerous pinkish teeth. Within this, come the stamens, about 20 in number, cream-coloured with the points of a pale claret colour. The fruit is soft, somewhat like a pomegranate; the rind contains so much tannin that a kind of ink is made from it in Africa. (*Myrtaceæ*).

84. *NEPHELIUM LIT-CHI*, *Camb.*—The Litchi Tree is a native of South China, and was first known in Pekin in the third century of our era. It was introduced into Bengal in the 18th century, and is now on account of its delicious fruit cultivated in India almost as extensively as the mango. The fruits are at their best when just picked, when they look like bright pinkish strawberries, and the pulp is then deliciously bitter-sweet. The edible portion is the semi-transparent jelly-like pulp or 'aril' which envelopes the seed, and is enclosed by a thin reddish brittle shell. The dried fruit is exported to Europe, but in this state bears no resemblance to the fresh berry. The tree is propagated by layering. (*Sapindaceæ*.)

85. *OLEA EUROPEA*, *Linn.*—The olive is cultivated for the olive-oil and for pickling olives. The best oil is obtained by passing the ripe fruit through a mill which bruises the flesh but does not crack the stones. The mass is then put into bags under a screw-press. Inferior qualities of oil are the result of boiling the cake obtained thus from the press, and again pressing it. The pickling olives are unripe fruit rendered less bitter by soaking in water to which lime and wood-ashes are sometimes added, and then boiling in salt-and-water flavoured with aromatics. The wood is used by cabinet-makers. (*Oleaceæ*.)

86. *OREODOXA REGIA*, *H. B. & K.*—"The American Palms," says Seemann, "may be said to have been anxious to appear to the best advantage, when they were about to form the acquaintance of those who were about to seek a new world in the west. They placed on the very threshold of their native country several representatives, which, in elegance and majesty of form, are equalled by few, and surpassed by scarcely any of the whole order of palms. Even ere the anxious voyager has set his foot on shore, he has already perceived their graceful foliage fluttering in the breeze, and waving, as it were, a hearty welcome to the newly-arriving stranger. Since the time when Columbus first discovered the West Indian Isles to the present day, these palms have been seen and admired by all who possess an eye for the beautiful."

The palms referred to are the Royal Palm of Cuba (*Oreodoxa regia*) and the Cabbage Palm of the West Indies (*Oreodoxa oleracea*). (*Palmeæ*).

87. *PACHIRA AQUATICA*, *Aubl.*—A tree with large handsome flowers, belonging to the same family as the Silk Cotton Tree and the Mahoe. It is a native of tropical South America and some of the

West Indian Islands. Some of the species yield good fibre from the bark. (*Malvaceæ*.)

88. *PACHYRHIZUS TUBEROSUS*, *Spreng.*—The Yam Bean has white flowers and red seeds. The root is formed of several simple fibres, several feet in length, bearing a succession of tubers.

The root affords a plentiful supply of wholesome food. The tubers may either be boiled plain, in which state they are a good substitute for yams and other roots in common use; or they may be submitted to a process similar to arrow-root, and a starch obtained. This starch is equal to arrow-root. Even the trash left after obtaining the starch, and which in the preparation of arrow-root is lost, may, when thoroughly dried, be formed into a palatable and wholesome flour. A very excellent flour may also be obtained by slicing the tubers, drying them in the sun, and then reducing to a powder. The ripe seeds are poisonous, but the pods when young may be eaten like French Beans. (*Leguminosæ*).

89. *PANDANUS UTILIS*, *Bory.*—The Screw Pines are so-called from the way in which their pine-like leaves grow in spiral fashion. They are nearly related to the Palms, and are remarkable for the way in which roots are put out from the stem. The tender tip of a root is protected in pushing through the soil by a cap, and this root-cap is very large and evident in the Screw Pines. When the roots reach the ground, they serve not only as feeders for the plant, but they also help to support it.

This species is a native of Madagascar, and is commonly planted in Mauritius for the sake of its leaves, "which are employed for the purpose of package-bags for the transportation of coffee, sugar and grain from one place to another, and for exportation. The preparation of the leaves for working into matting is simple and short. As soon as gathered, the spines on their edges and dorsal nerve are stripped off, and the leaves divided into slips of the breadth proper for the use they are required for."—(Hardwicke). (*Pandaneæ*).

90. *PHYTELEPHAS MICROCARPA*, *Ruiz & Pavon.*—The Vegetable Ivory of commerce is the hard white seed of this plant, which is a kind of palm with a trunk more or less recumbent. The hard woody fruit is as large as a man's head. The seeds when quite young, contain a clear water used by travellers to quench their thirst, afterwards this liquid becomes milky and sweet, and finally changes into a substance as hard and as white as ivory. (*Palmeæ*.)

91. *PTEROCARPUS DRACO*, *Linn.*—This is the Dragon's Blood tree of the West Indies. There are several plants known in different parts of the world as Dragon's Blood, but this one is a native of Jamaica, a tree about 30 feet high. The common name is derived from the fact that when incisions are made in the bark, drops of red sap ooze out which flow slowly down the bark and gradually harden.

Jacquin states that formerly this red resin was imported from Cartagena to Spain as "Sangre de Dragon." He also says that

the bark, wood, and leaves are full of an astringent sap, and that the inhabitants use the bark of the trunk and root for cleaning the teeth. It grows in Jamaica, Guadeloupe, Trinidad and in Central and northern South America.

The tree has compound leaves, somewhat like the common cedar; yellow pea-like flowers, half an inch long; and a flat rounded pod, containing one seed. (*Leguminosæ*.)

92. *QUASSIA AMARA*, Linn.—The wood is the original Quassia from Surinam which acquired reputation as a drug. When the demand exceeded the supply, it was found that a native tree of Jamaica (*Picraena excelsa*) was of equal value, which is known as Jamaica Quassia or Bitter Wood. (*Simarubaceæ*.)
93. *RANDIA MACULATA*, D C., A shrub 10 to 15 feet high, is a native of Africa. It is nearly related to *Gardenia*, and in fact it is often called in gardens *Gardenia Stanleyana*. The flowers are fragrant and coloured white spotted inside with purple. (*Rubiaceæ*.)
94. *RAPHIA RUFFIA*, Mart.—The *Raphia* Palm grows in brackish swamps in Madagascar. The trunk is not large but the pinnate leaves are often 50 feet in length. The *Raphia* fibre prepared from this Palm is quoted at 40/ per cwt. The fruit spikes are 6 feet long hanging down from amongst the leaves and weighing as much as 200 or 300 lbs. The fruits as large as eggs, are covered with shining overlapping scales. (*Palmæ*.)
95. *RAPHIA TÆDIGERA*, Mart.—The Jupati Palm, says Mr. Wallace, is one of the most striking of the many noble Palms which grow on the rich alluvium of the Amazon. Its comparatively short stem enables us fully to appreciate the enormous size of its leaves, which are at the same time equally remarkable for their elegant form. They rise nearly vertically from the stem and bend out on every side in graceful curves forming a magnificent plume seventy feet in height and forty in diameter. The stem does not generally exceed six or eight feet in height, and is about a foot in diameter, clothed for some distance down with the persistent sheathing bases of the leaf-stalks and the numerous spinous processes which proceed from them.
- The leaf-stalk of this tree is most extensively useful. It is often twelve or fifteen feet long below the first leaflets, and four or five inches in diameter, perfectly straight and cylindrical. When dried, it almost equals the quill of a bird for strength and lightness, owing to its thin hard outer covering and soft internal pith. But it is too valuable to the Indian for him to use it entire. He splits off the smooth glossy rind in perfectly straight strips, and makes baskets and window blinds. The remaining part is of a consistence between pith and wood, and is split up into laths about half an inch thick and serves for a variety of purposes. Window shutters, boxes, bird cages, partitions and even entire houses are constructed of it. In the little village of Nazaré near Para, many houses of this kind may be seen in which all the walls are of this material, supported by a few posts at the angles and

fastened together with pegs and slender creepers. The hand may be easily pushed through one of these walls, but as the inhabitants do not trouble themselves with the possession of any article worth stealing, they sleep as composedly as if stone walls and iron bolts shut them in with all the security of a more advanced civilisation. The same material is also used for stoppers for bottles. (*Palmae*.)

96. *RAVENALA MADAGASCARIENSIS*, *Sonner*.—The Traveller's Tree of Madagascar is one of the most beautiful and striking members of the Banana family. Its trunk is made up of the sheaths of the leaf stalks. At the top of the trunk the upper leaves are in two rows with long stalks, arranged like an enormous fan. As the wild pines of Jamaica hold water, which is sometimes of service to hunters in the woods, so the sheaths of the leaf-stalks of the Traveller's Tree store up water for the plants' own needs, and each one pierced from below, will yield the thirsty traveller half-a-pint of refreshing water. The blades of the leaves are used for thatch. The flowers are individually much like those of the Banana, but they are supported by large bracts arranged in two rows along the stalk. The seeds are edible, and are covered with a blue pulpy matter, which yields an essential oil. (*Musaceae*.)

97. *RHAPIS FLABELLIFORMIS*, *Ait.*—The Ground Rattan is a low-growing palm with a number of reed-like stems growing several together in dense tufts. It is a native of China and Japan.

The stems are very slender, and are made use of for various purposes. They are however quite distinct from the Rattan Cane. It is an excellent plant for table decorations and will stand the climate of the hills. (*Palmae*).

98. *SABAL PALMETTO*, *Lodd.*—The Palmetto of the southern United States has gained renown in two wars. The stems are extremely tough, and during the War of Independence, they were used with great success for making stockades. Hence the Palmetto was introduced into the arms of South Carolina; and on the breaking out of the Civil War, the Palmetto flag became a party emblem.

The stems attain a height of 40 feet; they are almost imperishable under water, not being attacked by the teredo, and are therefore of the greatest utility for making wharves.

The leaves of the Palmetto and also those of the Dwarf Palmetto (*Sabal Adansoni*) of the same region, are used for plaiting into light and durable hats. (*Palmae*.)

99. *SARCOCEPHALUS ESCULENTUS*, *Afzel.*—This small tree is a native of Upper Guinea. Its fruit, known as the Sierra Leone Peach, is really a union of small fruits as the Pine Apple is. The fragrant flowers are small, half an inch long, of a white pale pink or yellowish colour, and are crowded together into heads of about two inches in diameter. The edible fruit is thought by some to resemble the apple in flavour. (*Rubiaceae*).

100. *SEMECARPUS ANACARDIUM*, *Linn. f.* is the Marking Nut Tree of India. The juice of the nut is used for marking cotton clothes ; it is mixed with a little quicklime and water as a mordant. But it is so acrid in its nature, that care has to be taken in its use. It is also employed as a dye, colouring a greyish-black. It is, however, applied in India by the natives for rheumatism and sprains, for warts, and in scrofulous eruptions. This tree is related to the Cashew, but the receptacle (the Cashew fruit) is small in the Marking Nut Tree. (*Anacardiaceæ*.)
101. *SPATHODEA CAMPANULATA*, *Beauv.* grows to a height of 80 feet at Castleton. The branches do not spread, but the mass of rich orange-coloured flowers gives it a most attractive appearance. (*Bignoniaceæ*.)
102. *STERCULIA CARTHAGENENSIS*, *Cav.* called "Chica" by the Brazilians, and "Panama" by the inhabitants of the Isthmus, is a fine tree 40 to 50 feet high. It has become naturalized in the West Indies, and does well in the plains. The flowers are yellow, spotted inside with purple. The seeds are about the size of pigeons' eggs ; they have an almond-like taste, and are sometimes eaten. (*Sterculiaceæ*.)
103. *STRYCHNAS NUX-VOMICA*, *Linn.*—The seeds of this tree are known as Nux-vomica. They are flat and nearly round, and are bitter to the taste from containing three poisonous alkaloids, *strychnia*, *brucia*, and *igasuria*. The first of them is a very active poison, but possesses valuable tonic or stimulant properties. (*Loganiaceæ*.)
104. *TECTONA GRANDIS*, *Linn. f.*—This, the Teak Tree, is a native of central and south India, and Burma. As a timber its commercial value ranks next to Mahogany. "The sap-wood is white and small ; the heartwood when cut green has a pleasant and strong aromatic fragrance and a beautiful dark golden yellow colour, which on seasoning soon darkens into brown mottled with darker streaks. The timber retains its fragrance to a great age, the characteristic odour being apparent whenever a fresh cut is made. It is moderately hard, exceedingly durable and strong, does not split, crack, warp, shrink, or alter its shape when once seasoned, works easily and takes a good polish. It seems to require an annual rainfall of 30 inches, but to thrive best with from 50 inches to 120 inches mean annual rainfall."—(Gamble.)
It does not grow near the coast, but on low hills up to 3,000 feet, an essential being perfect drainage. (*Verbenaceæ*.)
105. *TERMINALIA ARJUNA*, *Bedd.*—The Arjun tree is a native of India and Ceylon. The bark is astringent ; it is given medicinally in heart diseases, contusions, &c., and is used in dyeing to produce a light brown or Khaki colour. (*Combretaceæ*.)
106. *THORINAX PARVIFLORA*, *Sw.*—The Royal Palmetto, or Palmetto Thatch Palm, is a native of Jamaica, Florida, and Central America. The stem is very slender, and sometimes attains a height of 40 feet. The fibre affords material for ropes. (*Palmae*.)

107. *VICTORIA REGIA*, *Lindl.*—The *Victoria regia* is certainly the queen of all water lilies, but in the narrow confines of the tank at Casleton, it is unable to expand to its full size and beauty.

The first printed notice of this lily was in D'Orbigny's "*Voyage dans l'Amérique méridionale*," published in 1835. He says, "I resumed my descent of the Paraná, and arriving at the junction of a small river called the San Jose, which spreads into a wide marsh before falling into the Paraná, I found one of the most beautiful flowers that America can produce. The people of Guiana call it *Irupé*, deriving this name from the shape of its leaves, which resembles the broad dishes used in the country, or the lids of their large round baskets. A space more than a mile broad and nearly a mile long, is covered with the large floating leaves, each of which has a raised edge two inches high. The foliage is smooth above and furrowed below with numberless regular compartments formed by the projecting, thick, hollow nerves, the air in which keeps the leaf upon the surface of the water. Leaf stalks, flower stalks, and ribs of the leaves, are alike cellular and covered with long prickles. Amid this expanse of foliage rise the broad flowers, upwards of a foot across, and either white, pink, or purple; always double, and diffusing a delicious odour. The fruit, which succeeds these flowers, is spherical, and half the size, when ripe, of the human head, full of roundish farinaceous seeds, which give to the plant the name of water maize (*Mais del Agua*), for the Spaniards collect the seeds, roast and eat them. I was never weary of admiring this Colossus of the Vegetable Kingdom, and reluctantly pursued my way the same evening to Corrientes, after collecting specimens of the flowers, fruits, and seeds."

Sir Robert Schomburgh discovered it in British Guiana, and gave the following account to the Royal Geographical Society:—

"It was on the 1st of January, 1837, while contending with the difficulties that nature interposed in different forms, to stem our progress up the river Berbice that we arrived at a part where the river expanded and formed a currentless basin. Some object on the southern extremity of this basin attracted my attention, and I was unable to form an idea what it could be; but, animating the crew to increase the rate of their paddling, we soon came opposite the object which had raised my curiosity, and behold, a vegetable wonder! All calamities were forgotten, I was a botanist, and felt myself rewarded! There were gigantic leaves, five to six feet across, flat with a broad rim, lighter green above and vivid crimson below, floating upon the water; while in character with the wonderful foliage, I saw luxuriant flowers, each consisting of numerous petals, passing in alternate tints, from pure white to rose and pink. The smooth water was covered with the blossoms, and as I rowed from one to the other, I always found something new to admire. The flower-stalk is an inch thick near the calyx and studded with elastic prickles, about three-quarters of an inch long. When expanded, the four-leaved calyx measures a foot in diameter, but is concealed by the expansion of the hundred petaled corolla. This beautiful flower, when it first unfolds, is white with a pink centre; the colour spreads as the bloom increases in age; and, at a

day old the whole is rose-coloured. As if to add to the charm of this noble Water-Lily, it diffuses a sweet scent. As in the case of others in the same tribe, the petals and stamens pass gradually into each other, and many petaloid leaves may be observed leaving vestiges of an anther. The seeds are numerous and imbedded in a spongy substance. Ascending the river, we found this plant frequently, and the higher we advanced, the more gigantic did the specimens become; one leaf we measured was six feet five inches in diameter, the rim five inches and a half high and the flowers a foot and a quarter across." (*Nymphæaceæ*.)

108. *ZAMIA INTEGRIFOLIA*, *Ait.*.—A native of dry sea-coasts in Jamaica, is represented by a specimen at the base of the Moriche Palm. It is nearly allied to *Cycas*, and also yields starch. (*Cycadaceæ*.)

109. *ZINGIBER OFFICINALE*, *Roscoe*.—Ginger is the dried root-stock of *Zingiber officinale*, a plant with leafy stems, 3 or 4 feet high, distinct flowering stems 6 to 12 inches high with small, yellow and purple flowers in a cone-like head.

Small pieces or protuberances of the root-stock 1 or 2 inches long are planted during March or April, 4 inches deep and 9 to 12 inches apart. It is well to cover the land with a moulding of dead leaves, weeds, straw, or litter, mixed with manure. In a few months the whole ground will be covered. The flowers appear in September. When the stalks wither in the following January or February, it is time to dig up the roots. When the tubers have become mature, and have put forth stems, they are fibrous; but before this takes place, while they are still succulent, and the young stalks are no more than 5 or 6 inches long, they should be taken up for preserving. Ginger is an exhausting crop on the soil, and should not be planted in the same ground two consecutive years.

"Black Ginger" of commerce is prepared by washing the root in water, boiling for a quarter of an hour, and then drying in the sun. "White Ginger," a much superior article, is prepared from the best and soundest roots, by scraping off the outer dark-coloured part, and then carefully drying without boiling. "Preserved Ginger" is made from the young tubers, which are scalded, washed in cold water, and then peeled. The roots are then covered with a weak syrup, and left for two days. The syrup is then poured off, and replaced by a stronger syrup, and this is repeated two or three times, until the syrup is thick, and the ginger bright and nearly transparent. The yield per acre is said to be 4,000 lbs. and upwards. (*Zingiberaceæ*.)

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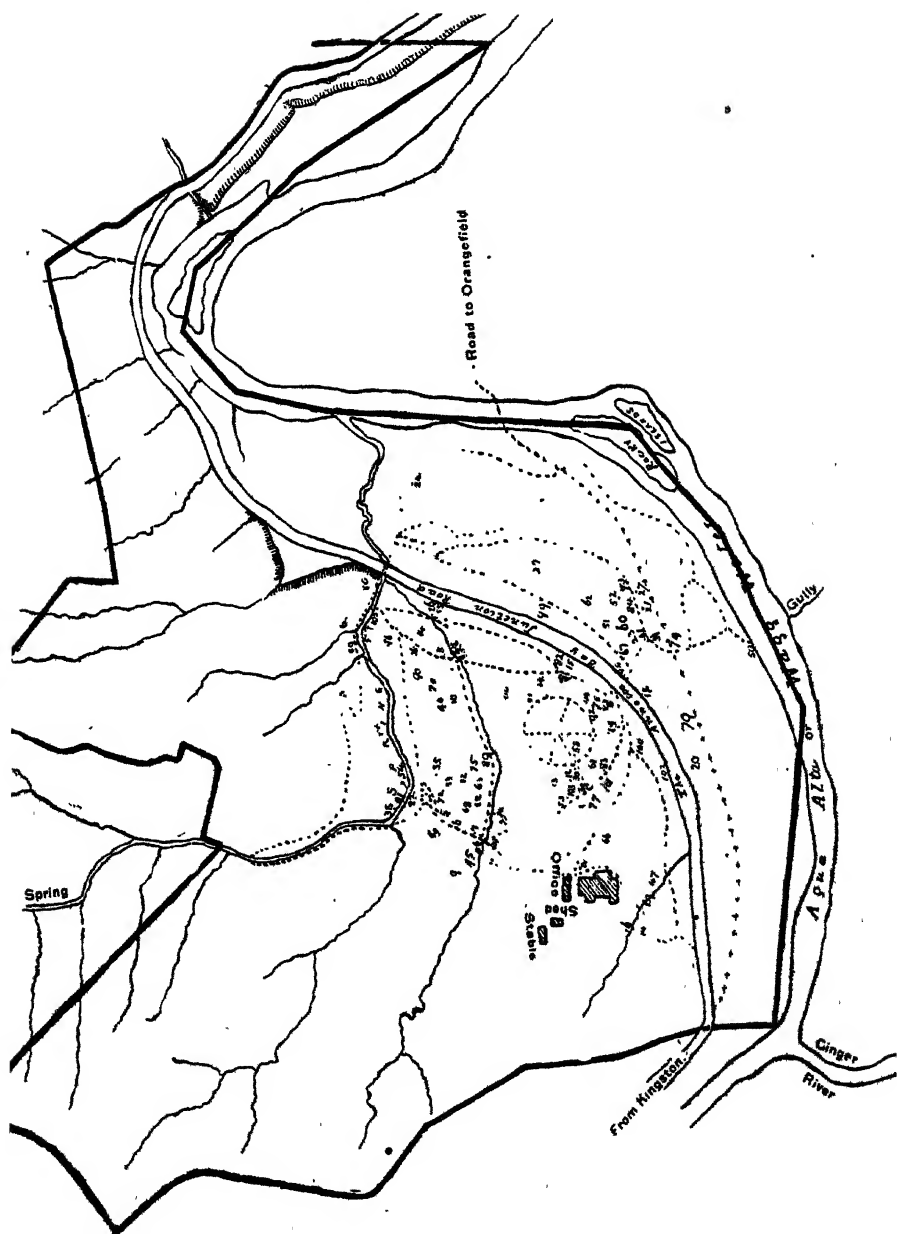
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PLAN of CASTLETON GARDEN.

Scale—about 6 chains to the inch.

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